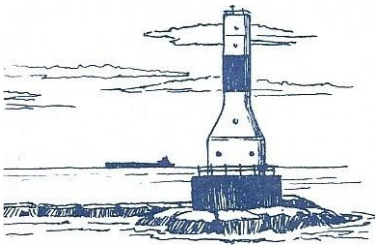


CONNEAUT PORT AUTHORITY

CITY OF CONNEAUT, OHIO

929 Broad Street, Conneaut, Ohio 44030

(440) 593-1300

www.conneautportauthority.com

Conneaut Coastal Resilience Plan

Authored By: Environmental Consulting & Technology

Version 3

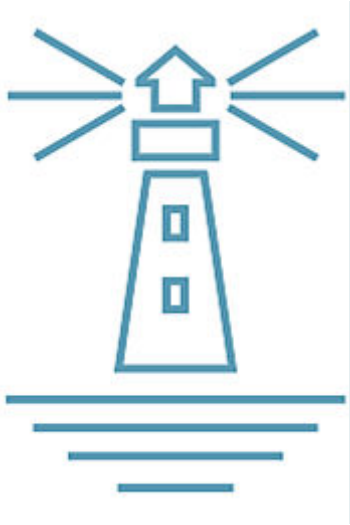
Updated: 6/13/2025

Table of Contents

EXECUTIVE SUMMARY

Note to readers – any yellow highlighted text will be completed in the draft final version of this document anticipated in August 2025. These sections need additional public, stakeholder, and partner input.

The Executive Summary Section will be completed for the final draft.



Chapter 1. Introduction

1. Introduction

The Great Lakes Basin is one of the largest freshwater ecosystems in the world, serving as a vital resource for millions of people, wildlife, and ecosystems. The Basin contains 84% of North America's surface freshwater and approximately 21% of the world's supply of surface freshwater (EPA 2025). These bodies of water are a critical source of drinking water, recreation, transportation, agriculture, and economic activity for the surrounding states and communities. However, the increasing effects of climate change threaten the delicate balance of this ecosystem, exacerbating existing environmental challenges and creating new risks. Rising temperatures, shifting precipitation patterns, and more frequent extreme weather events are altering water quality, threatening biodiversity, and impacting the livelihoods that depend on the lakes (U.S. Climate Resilience Toolkit, n.d.). Issues such as harmful algal blooms, invasive species, shoreline erosion, and flooding are becoming more pronounced as the climate continues to change. These challenges not only affect the ecological health of the lakes but also have significant social and economic implications for the communities that depend on them.

The city of Conneaut, Ohio, on the southern shore of Lake Erie in Ashtabula County, has been experiencing climate-related impacts for years, particularly along its shoreline near the Conneaut Port and harbor; Conneaut's shoreline is affected by more frequent and severe storms, droughts, and flooding impacts from both land and sea. This area contains critical maritime and commercial infrastructure, with the port and rail system serving as a major receiving hub for commodities including iron ore, steel, aggregates, minerals, limestone, and food and farm products. Waterborne transportation facilitated by the harbor supports $180.5M in business revenue, 771 direct, indirect, and induced jobs, and $56M in labor income each year (U.S. Army Corps of Engineers 2024).

Inland development channels untreated rainwater runoff containing nutrient and sediment pollution directly into the lake, adversely affecting water quality (U.S. Environmental Protection Agency 2003). For example, waterways such as the drainage systems in Conneaut Township Park and Conneaut Creek are experiencing bank and slope erosion, leading to accelerated sediment transport and nutrient loading in Lake Erie, particularly in areas surrounding the port and marina (Roloson 2005). Erosion is also occurring at bluff residences west of the Port. These residences face risks of coastal erosion and flooding due to increased storm events and wave action, as do nearby roadways, Lake Road and Naylor Drive, which provide access to homes and community infrastructure, including schools, local government facilities, churches, and the marina.

In addition, this area provides some of eastern Ohio's most accessible outdoor recreation opportunities, which is at risk due to natural hazards. Conneaut provides some of Eastern Ohio's most accessible outdoor recreation opportunities. Over the past 50 years, eastern Ohio's economy has shifted from manufacturing and heavy industry (e.g., coal) to the service sector, and opportunities in the outdoor tourism industry have grown (Shields 2018). Conneaut's beaches are a popular warm-weather destination for people in the region, and the Conneaut marina serves both commercial and recreational boaters and anglers throughout the spring, summer, and fall. Conneaut harbor is considered one of Lake Erie's legendary birding hotspots, according to the Ohio Ornithological Society, with "scores of rarities" being observed such as the Piping Plover (*Charadrius melodus*) a federal endangered species within the Great Lakes with breeding habitat along the Conneaut shoreline, Red Phalarope (*Phalaropus fulicarius*), Purple Sandpiper (Calidris maritima), and Black-headed Gull (*Chroicocephalus ridibundus*) (Ohio Ornithological Society, n.d.). Conneaut Harbor is stop #1 on the Lake Erie Birding Trail (within the Ashtabula Loop), a trail program administered by the Ohio Division of Wildlife within the Ohio Department of Natural Resources (ODNR) (ODNR 2025). Being the first stop on a state-recognized birding trail highlights Conneaut Harbor as a

premier destination for wildlife viewing, especially birding, which is a growing sector in nature-based tourism. It underscores the harbor's ecological significance and its role in outdoor recreation and conservation.

In addition, Conneaut has a thriving recreational fishing industry with many charter companies launching from the marina, and fly fishermen frequenting Conneaut Creek, a State Wild and Scenic River. Conneaut Creek supports over 78 species of fish, 32 species of amphibians and reptiles, and 30 unique plants and plant communities (Ohio Department of Natural Resources, n.d.). Salamander mussels (*Simpsonaias ambigua*), a state threatened and federally proposed endangered species, are also known to inhabit the area (Welte 2020).

CPA's focus on infrastructure improvements, environmental protection, and thoughtful planning for recreational and economic development lays the groundwork for a future in which Conneaut thrives as a hub of community pride, environmental responsibility, and economic vitality.

In 2023, with a vision centered on community, and an awareness of emerging economic drivers and opportunities, the Conneaut Port Authority (CPA) initiated the planning and design of a marina redevelopment project. This conceptual revitalization, known as the Master Plan, encompasses several key components: economic enhancements, such as the development of commercial properties; safety and access improvements, including pedestrian walkways and road upgrades; the expansion of outdoor recreational opportunities, such as the addition of boardwalks for birdwatching; and ecological restoration and climate resilience initiatives. Climate resilience refers to the capacity of social and ecological systems to absorb and adapt to the shocks and stresses induced by a changing climate, thereby positioning themselves to respond more effectively in the future. Climate resilience involves not only

Figure 1. Master Plan Resilience Projects

enduring climate impacts but also thriving in an evolving environment. Incorporating climate resilience elements such as living shorelines, functioning wetlands, dune and beach enhancement, etc., into the Master Plan was a focus of CPA's, following their mission statement to "*provide Conneaut a safe and environmental-friendly community through development and recreational opportunities in collaboration with community partners*". In the Master Plan, five specific areas within the larger redevelopment footprint are identified as possible locations for climate resilience projects: the sandbar, Marina Drive extension, Canadian National Lakefront, the shoreline east of the port, and the lagoon (Figure 1).

1.1. Plan Purpose

Planning for a climate-resilient future is about preparing for the inevitable changes ahead, protecting current and future generations, and ensuring that people, ecosystems, and economies can continue to thrive despite the challenges posed by natural hazards. A dedicated advocate for community resilience, the CPA, following their mission statement and understanding that public and stakeholder engagement will provide the necessary collaboration and support for a successful redevelopment, decided to build upon the Master Plan and develop the Conneaut Costal Resilience Plan (Plan). This plan's purpose is to identify the climate impacts along Lake Erie, assess how these impacts may affect CPA's redevelopment efforts, and establish the priorities for CPA and the community in adapting and protecting the coast. It focuses on identifying viable strategies for resilience that are both practical and equitable.

Long-term planning is a proactive way to enhance preparedness for the impacts of coastal hazards and account for the variability of the Great Lakes water levels, coastal storms, and changes to the system associated with a changing climate. A resilience plan enables coastal communities to prepare for and adapt to environmental changes, thereby protecting residents, supporting the economy, and preserving natural resources while ensuring long-term sustainability. Planning for a climate-resilient future is critical for several important reasons:

- **Protecting People and Communities:** As climate change brings more frequent and intense weather events, such as floods, storms, heatwaves, and wildfires, planning for resilience helps protect vulnerable communities from the health, safety, and economic impacts of these events. It ensures that infrastructure, homes, and businesses are better prepared for extreme conditions, reducing the risk of loss of life and property damage.
- **Safeguarding Ecosystems and Biodiversity:** Resilience planning can help protect natural habitats, preserve biodiversity, and ensure that ecosystems continue to provide vital services, like clean water, food, and carbon sequestration, which are essential for human survival.
- **Economic Stability and Growth:** Extreme weather events and climate impacts can disrupt economies by damaging infrastructure, agriculture, and supply chains, leading to financial losses. By planning for resilience, communities and businesses can reduce the economic risks posed by climate change, ensuring long-term sustainability. This includes adapting agricultural practices to changing weather patterns and investing in resilient infrastructure that can withstand future climate challenges.
- **Fostering Sustainable Development:** Climate resilience is closely linked to sustainability. Planning for a resilient future ensures that development today does not undermine the ability of future generations to meet their needs. This involves making informed decisions about land use, energy consumption, and resource management, which helps balance economic, environmental, and social objectives in the face of climate change.
- **Reducing the Costs of Inaction:** The cost of not planning for climate resilience is far greater in the long run. Without proactive measures, the damage caused by extreme weather events, sea-level

rise, and other climate impacts will continue to increase, leading to costly repairs, health crises, and economic instability. Investing in climate resilience today can prevent far more expensive damage in the future, helping to protect both people and economies.

- **Building Adaptive Capacity:** Planning for resilience helps individuals, businesses, and governments build the adaptive capacity needed to respond to changes. It includes developing skills, knowledge, and infrastructure that allow people and systems to bounce back after disruptions, reducing the need for recovery and ensuring long-term stability.

1.2. Plan Goals & Objectives

This Plan addresses the coastal resiliency issues impacting a six-mile section of Lake Erie coastline at the easternmost end of Ohio (Figure 2). The study area is approximately centered on Conneaut Harbor and features various shoreline conditions; The western portion includes high bluffs with residential areas, while the harbor area consists of an impounded beach, coastal marsh habitat, and a reinforced industrial port. The six-mile study area was selected due to its direct influence on the CPA and the community of Conneaut as well as its alignment with the divisions outlined in the Lake Erie Shore Erosion Management Plan (LESEMP) developed by the ODNR (ODNR 2020a).

The goal of the Plan is to identify, describe, and prioritize potential green infrastructure coastal resilience projects within the six-mile study area to provide fish and wildlife benefits and enhance long-term community resilience and in Conneaut, Ohio. To achieve this goal, the CPA has identified the following Plan objectives:

- Foster meaningful and inclusive public engagement by providing transparent, accessible and collaborative opportunities for community and stakeholder input into the development of the Plan.
- Develop feasible, nature-based restoration, conservation, and resilience priority projects in and around Conneaut.
- Provide community organizations with project descriptions that can be used to apply for and receive design, permitting, and implementation funding.
- Provide a strategic pathway for state, federal, and local entities to restore, enhance, and protect coastal infrastructure and habitats and advance the state and local resiliency goals set forth in various national, state, regional, and local planning documents.
- Create a living document that can be emulated by other Port Authorities and similar organizations for future resilience planning work.

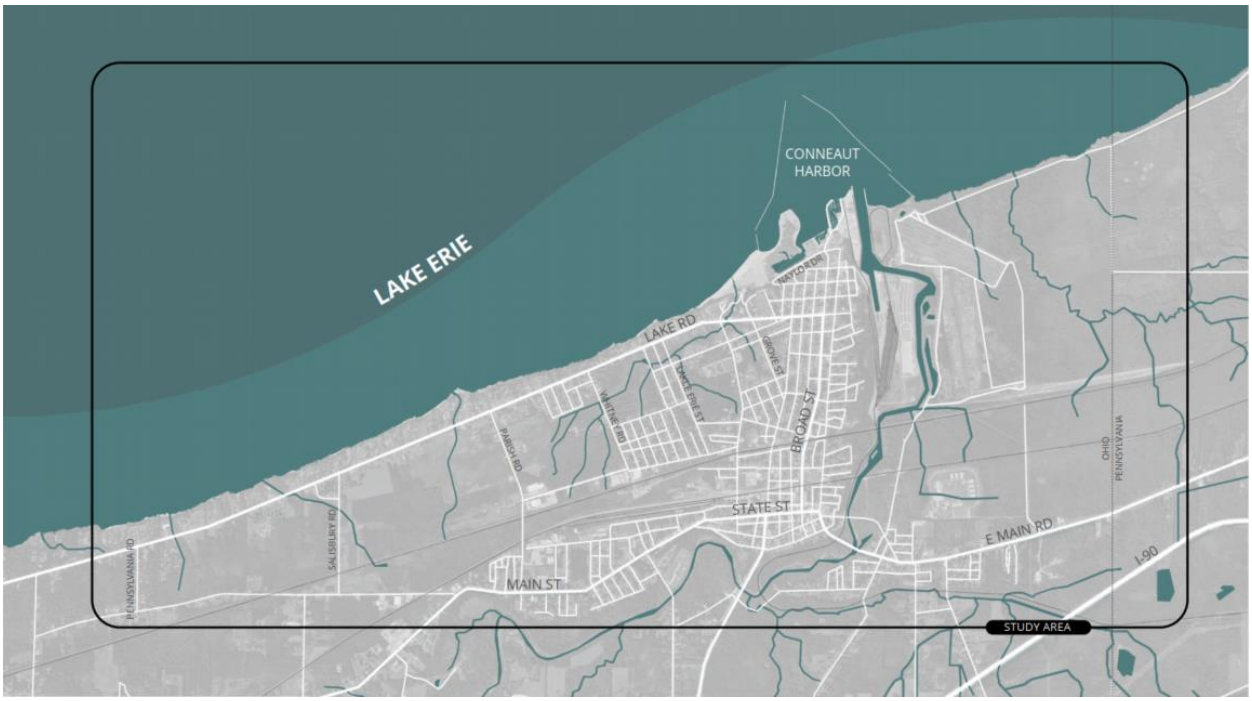


Figure 2. Plan Boundary & Study Area

1.3. Plan Structure

The Plan utilizes a funnel structure to provide the reader with a strategic framework that begins broadly with overarching restoration concepts and regional project examples and progressively narrows in focus to specific resilience actions and site-specific projects. This organization ensures that the Plan is both visionary and actionable, moving from high-level direction to ground-level implementation. It also enables flexibility for future amendments and updates, facilitating adaptive management by maintaining overarching objectives while specific actions and projects can be adjusted as needed. This approach essentially creates a dynamic and evolving document.

Figure 3. Plan Structure

It's important for the readers and users of this Plan to understand the national, regional, and state resilience efforts that have occurred, as this Plan should build off previous scientific and strategic work. There are many tried and true restoration and resilience strategies that CPA and other organizations can rely on for mitigating the impacts of climate change and natural hazards. Describing the existing and future environmental conditions of the Conneaut area provides context why certain resilience and restoration strategies were ultimately selected for site specific projects.

The projects outlined in this Plan are the result of extensive research, site visits, and input from the public and stakeholders. The cornerstone in developing the Plan has been community engagement, which has given CPA the ability to consider diverse

perspectives and experiences, to advocate for the importance of climate resilience planning, promote the use of green design, and build support for the marina redevelopment. The engagement efforts (outlined in Section 2) provided stakeholders and the public multiple opportunities to express their concerns about and support for the redevelopment, propose potential nature-based solutions and project ideas, and provide comments on the Plan. The overall engagement work that has been completed to date illustrates to future project funders CPA's dedication to public input and participation.

1.4. Previous Planning Efforts

To capitalize on the extensive benefits of prior planning efforts, technical research, and resilience resources, the planning team reviewed numerous relevant studies and documents that align with CPA's scope, goals, objectives, and desired outcomes. Multiple planning and analysis initiatives by federal, state, and local governments, agencies, and organizations have been undertaken to assess existing waterfront resources and to explore strategies for safeguarding, reinforcing, and enhancing these resources for the future. These technical documents provided valuable insights for the development of nature-based coastal resilience projects within the Plan. Additionally, the Plan draws upon previous stakeholder contributions, including information from existing conditions reports, guidance documents, and manuals focused on reducing erosion, stabilizing shorelines, improving and building wetlands, and implementing ecological restoration in the Great Lakes region. Below is a subset of the documents reviewed and referenced during the Plan's development.

Ashtabula County Coastal Management Plan, Ashtabula County (2013)

The Ashtabula County Coastal Management Plan examined major opportunities and challenges associated with the county's 30 miles of Lake Erie shoreline, and identified ways in which residents and communities can make informed decisions on how to protect, develop, and benefit from the resources provided by the Lake. Conneaut Port was identified as a Priority Development Area, and Conneaut Township Park was identified as a Priority Conservation Area (Ashtabula County 2013). The coastal management plan also highlighted the importance of tourism, especially environmental tourism, as an economic generator for the County.[1]

Figure 4. Ashtabula County Coastal Management Plan

[1] Photo Credit: Ashtabula County, OH from ashtabulacounty.us

City of Conneaut 2017 Comprehensive Plan Update, City of Conneaut (2018)

Figure 5. 2017 Comprehensive Plan Update

Conneaut's comprehensive plan is a set of policy statements intended to guide future land use and physical development. This work built on the elements of previous plans while looking 10+ years into the future. The plan's policy framework includes strengthening the economy, highlighting the importance of expanding housing and recreational offerings while embracing tourism, and identifying Conneaut Port as a priority economic development area. The plan's policy framework also includes preserving, conserving, and managing green space, highlighting several waterfront resources as critical for management and protection, and identifying Conneaut Township Park as a priority conservation area. This Plan relies on the some of the goals and desires of the residents, specifically targeting the framework and actions for management of critical water resources near the Port and Township Park. [2]

Conneaut Charrette Harbor Plan, Kent State Cleveland Urban Design Collaborative (2016)

As a follow up to the 2014 *Conneaut Charrette Report*, Kent State's Cleveland Urban Design Collaborative developed design proposals for improvements along Conneaut's harbor. The plan included enhanced crosswalks, new parking, a public outdoor deck, a renovation of the existing fisheries building, event space, a waterfront pavilion, multi-use retail storefronts, a new housing development, and a redeveloped public park featuring marsh and wetland rehabilitation as well as the expansion of nature-based recreational opportunities. This collaboration served as a basis for the design and creation of the coastal marsh rehabilitation, and the marina drive reconstruction listed in Section 5.

Conneaut Charrette Report, Kent State Cleveland Urban Design Collaborative (2014)

Figure 6. Conneaut Charrette Report

Students, staff, and alumni from Kent State University's Cleveland Urban Design Collaborative (CUDC) worked closely with community members in Conneaut, Ohio to generate a shared vision for the city's future. The main goals for the project mostly overlap with the focus and intended outcome of this Plan, and included: (1) Focus on lakefront assets. (2) Increase tourism by connecting Conneaut to regional destinations and attractions. (3) Connect existing assets within Conneaut by linking sites of interest from the lake to the highway. (4) Promote year-round outdoor activity. (5) Enhance scenic routes for cycling. (6) Encourage multiple modes of transportation through identification of opportunities for bikes, snowmobiles, and golf carts. (7) Diversify and expand housing options through attracting tourists to become residents. (8) Reveal Conneaut's history and identity by developing wayfinding and public art strategies. (9) Revitalize key nodes by reinforcing important places that embody Conneaut's heritage. CPA's

[2] Photo Credit: City of Conneaut, OH from conneautohio.gov

redevelopment efforts and this Plan will help achieve these goals proposed over eleven years ago.[3]

Guidance for Considering the use of Living Shorelines, National Oceanic and Atmospheric Administration (2015)

In 2015 the National Oceanic and Atmospheric Administration (NOAA) developed in an agency-wide effort, the Guidance for Considering the use of Living Shorelines, to clarify NOAA's encouragement for the use of living shorelines as a shoreline stabilization technique along sheltered coasts (coasts not exposed to open ocean wave energy). The document outlines NOAA's guiding principles an organization should consider when taking into consideration living shorelines as a resilience technique, how and why NOAA is encouraging the use of living shorelines, and how to navigate potential regulatory permitting when planning for shoreline projects (NOAA 2015). The proposed living shoreline project outlined in Section 5 draws from the techniques listed in this guidance document. [4]

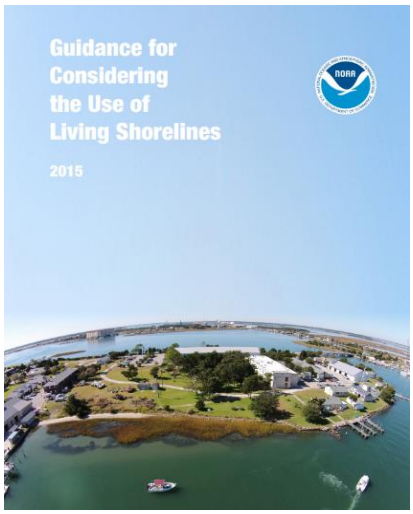


Figure 7. Guidance for Considering the Use of Living Shorelines

Lake Erie Shoreline Erosion Management Plan, ODNR (2020)

Figure 8. Lake Erie Shore Erosion Management Plan

The Lake Erie Shore Erosion Management Plan (LESEMP) is a partnership through ODNR between OCM, Division of Wildlife, and the Division of Geological Survey. LESEMP is an ongoing effort to assist local communities and individual property owners in the management of coastal erosion. The LESEMP encompasses a comprehensive array of information and subjects, including coastal geology, erosion processes, critical habitats, and the cultural attributes of local communities, and defines locations along the Lake Erie shoreline as "reaches". Conneaut is described within reaches 10 and 12 (ODNR 2020a). It also explains the various causes of shoreline erosion and provides general erosion rates for each coastal county. Ashtabula County, as detailed in plan, has lost approximately 82 feet of shoreline from 1877 to 1973, and approximately 28 feet from 1973 to 1990, indicating that the rate of erosion has increased from nearly one foot per year to about 1.6 feet per year (ODNR 2020a). The plan further details specific recommendations to mitigate the impacts of erosion that are intended to serve as a best practices for the management of erosion along Ohio's coast. These erosion control measurements include beach nourishment, bulkheads, drainage systems, dune construction, regrading/terracing, revetments, sand bypassing, seawalls, and planting of vegetation. The prioritized

[3] Photo Credit: Kent State University - Cleveland Urban Design Collaborative 2014 from webgen1files.revize.com
[4] Photo Credit: National Oceanic and Atmospheric Administration from habitatbluepring.noaa.gov

resilience projects in Section 5 relied on the LESEMP to select suitable strategies to mitigate erosion. Specific projects such as the beach replenishment east of the port and the reconstruction of the marina drive and construction of wetland, were chosen based on selected LESEMP erosion control methods and reach designation. [5]

Lake Erie 2019-2023 Lakewide Action & Management Plan, Environment and Climate Change Canada and US Environmental Protection Agency (2021)

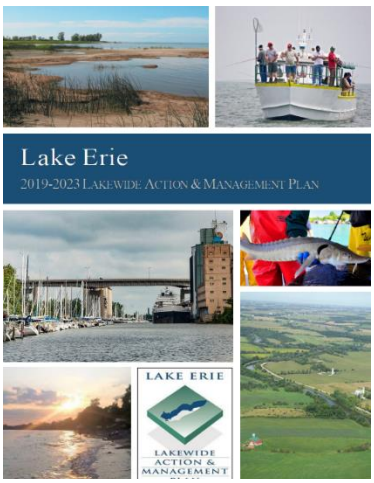


Figure 9. Lake Erie 2019-2023 Lakewide Action & Management Plan

The Lake Erie Lakewide Action and Management Plan (LAMP) is an ecosystem-based strategy for protecting and restoring the water quality of Lake Erie, the St. Clair River, Lake St. Clair, and the Detroit River. The LAMP was developed and implemented by the Lake Erie Partnership, led by the U.S. Environmental Protection Agency (EPA) and Environment and Climate Change Canada (ECCC) and in collaboration with other federal, state, provincial, tribal, First Nation and local watershed management authorities (ECCC 2021). The LAMP reports on the status of the Lake and the status of the Great Lakes Water Quality Agreement General Objectives (GLWQA). The conditions of habitats and native species, nutrients and algae, invasive species, and groundwater impacts were reported as "poor" and considered priority threats to the waters of Lake Erie. Actions to target these threats was developed by the LAMP and are grouped into the following categories: (1) Preventing and reducing nutrient and bacterial pollutions; (2) Preventing and reducing chemical contaminant pollutions; (3) Protecting and restoring habitat and native species, and; (4) Preventing and controlling invasive species. Several of the projects outlined in Section 5 of this Plan align with the actions listed under each strategy of the LAMP. For example, the Conneaut Creek shoreline assessment project falls under the actions to prevent and reduce bacterial, chemical, and nutrient pollution through science, surveillance, and monitoring. The wetland park and boardwalk project falls under the actions to prevent and reduce nutrient and bacterial pollution through the management of surface water runoff through green infrastructure. [6]

Living on the Coast - US Army Corps of Engineers, University of Wisconsin Sea Grant Institute (2003)

In 2003 the U.S. Army Corps of Engineers (USACE) partnered with the University of Wisconsin Sea Grant Institute (WISGI) to explore the results of natural processes, plausible climate change scenarios, and human influences affecting Great Lakes coasts. The purpose of this investigation was to better understand the risks from natural coastal hazards when owning, buying, or building residential, commercial, or industrial developments along the shoreline. Lake level responses were identified as a natural risk and specifically mentioned as the midcontinental Great

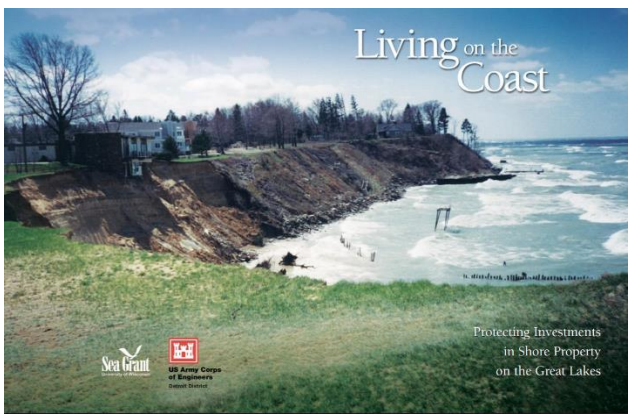


Figure 10. Living on the Coast Final Document

[5] Photo Credit: Ohio Department of Natural Resources from ohiodnr.gov

[6] Photo Credit: Lake Erie Partnership from binational.net/wp-content/uploads/2021/11/EN-2019-2023-Lake-Erie-LAMP.pdf

Lakes basin is subject to harsh, rapid changes in weather and climate (USACE 2003). Storm surges, local wave conditions, longshore and cross-shore transport of sediment, and shoreline erosion were also identified as risks when considering shoreline development. Amidst these natural risks, four strategies, adaptation, restoration of a natural shoreline, erosion moderation, and armoring the shore, were discussed and cited as defense options. Several of the projects outlined in Section 5 of this Plan fall under the four overarching strategies cited by USACE and WISGI. Specifically, the coastal marsh rehabilitation, marina drive reconstruction, and wetland construction projects proposed later in this plan are within the restoration of natural shoreline techniques, and bank stabilization at Kelsey's run and the creek/ravine stabilization at Turkey Creek Park fall under the erosion moderation techniques proposed by USACE and WISGI. [7]

Ohio Coastal Design Manual, 1st Edition, ODNR, Office of Coastal Management (2011)

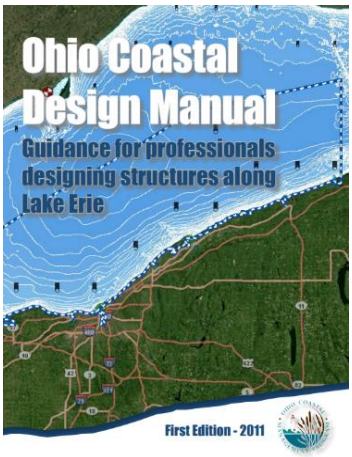


Figure 11. Ohio Coastal Design Manual

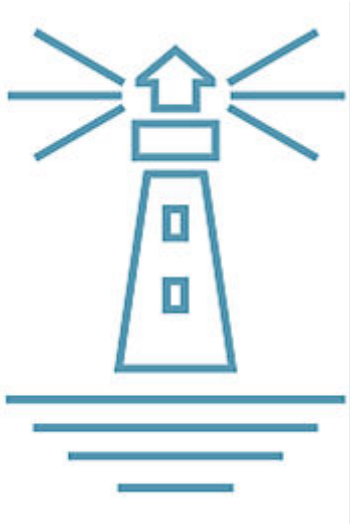
The ODNR Office of Coastal Management (OCM) prepared a design manual in 2011 for engineers, surveyors, and contractors to consider and use when developing along the Lake Erie shoreline. The 2011 design manual is intended to be corroborated with the Lake Erie Shore Erosion Management Plan (LESEMP) which details what types of erosion control are best suited for specific locations and conditions along the lake. While the LESEMP identifies the types of erosion controls that function best along a section of shoreline, the design manual shows how said structures should be designed (ODNR 2011). The design manual and LESEMP were considered when choosing the projects outlined in Section 5 as a way to ensure compatibility of a project with the location as described in the LESEMP "reaches" and overall project design. [8]

Ohio Coastal Atlas, 3rd Edition, ODNR OCM (2018)

Figure 12. Ohio Coastal Atlas 3rd Edition

In 2018 the ODNR OCM updated the Ohio Coastal Atlas with the intent of providing a detailed description of the historical, cultural, physical, and natural resources of Lake Erie for coastal and community decision makers and resources managers. The Coastal Atlas gives detailed information on the following topics: (1) Lake Erie Watershed; (2) Lake Erie's role in western expansion and settlement of Ohio; (3) Transportation and waterborne commerce; (4) Land use; (5) Protected lands; (6) Outdoor recreation and public access; (7) Lake Erie's ecosystem and habitat types; (8) Coastal processes, bathymetry and geomorphology; (9) Soils; (10) Geology and the formation of Lake Erie, and; (11) Water resources, among many other topics. (ODNR 2018). The Coastal Atlas, like the Ohio Coastal Design Manual and LESEMP, was consulted during development of this Plan to inform Sections 3 and 5. [9]

[7] Photo Credit: U.S. Army Corps of Engineers from shorelineparentership.org
[8] Photo Credit: Ohio Department of Natural Resources from ohio.dnr.gov
[9] Photo Credit: Ohio Department of Natural Resources from ohio.gov



Chapter 2. Public Outreach & Community Engagement

2. Public Outreach & Community Engagement

Public involvement is not an afterthought in the decision-making process, but rather a core tenet for agencies, organizations, partners, and individuals to evaluate, plan, prioritize, design, construct, and maintain projects that benefit the community. Engaging the public early and often can also help avoid costly re-work and delays later in the project lifecycle, including potential litigation or complaints from community members. Building off previous planning efforts, including the 2023 Master Plan, the CPA made a point to begin community and stakeholder communication early in the development of the Coastal Resilience Plan. Engagement was driven by a Public Participation Plan (PPP) that was created for this planning effort (Appendix A). The purpose of the PPP is to create a structured approach for involving the public in the development of the Resilience Plan, ensuring that their input is considered, thereby fostering a more inclusive decision-making environment.

2.1. Stakeholders & Communities

CPA, an active organization within the community of Conneaut, has built relationships with various community members, groups, leaders, businesses, and associations, and utilized these already established connections to begin the conversation regarding coastal resilience and how it relates to the planned marina redevelopment. CPA began the process of contacting their vast network of potential stakeholders (defined herein as the state and federal regulatory agencies and other technical entities) and community organizations in May 2024 to gauge interest in participating in this planning effort. Around the same time, the planning team began conducting research into other similar resilience projects that are occurring within the state of Ohio, as well as in other Great Lake states, to learn which community groups and regulatory bodies were engaged as part of those efforts. This information was used to help grow CPA's network and to reach as many interested parties as possible. Table 1 summarizes these efforts; all these organizations were involved in the engagement activities and had various opportunities to provide input into the Plan.

Table 1. Stakeholders and Community Organizations

Stakeholder Organizations	Community Organizations	
Ashtabula Metro Parks	Ashtabula County	Conneaut Foundation
Canadian National	Ashtabula County Port Authority	Conneaut Library
City of Conneaut	Ashtabula County Tourism Board	Conneaut Township Park
Conneaut Port Authority Board	City of Conneaut-Municipal Government	Kent State University Ashtabula
National Oceanic and Atmospheric Administration - National Marine Fisheries	Civic Development Corporation	Ohio Sea Grants
Ohio Department of Natural Resources	Clevland Port District	Residents & Community Members
Ohio Department of Transportation	Conneaut Area Historical Society	
Ohio Environmental Protection Agency	Conneaut Chamber of Commerce	
United States Army Corps of Engineers	Conneaut Convention and Visitors Bureau	

2.2. Engagement Efforts

Understanding the interests, concerns, and needs of the public and stakeholders is crucial for any organization aiming to effectively engage with its community and make informed decisions. CPA's approach to gaining a comprehensive understanding of the community and stakeholders' needs, interests, and concerns is multifaceted. The first step was to conduct virtual outreach to those entities in

Table 1 via email and phone calls. Through initial outreach, the purpose, need, and goals of the Resilience Plan, were discussed and CPA was able to gauge their interest in participating in the development of the Plan. Throughout the engagement process, CPA engaged in direct and regular communication with the outreach group through social media updates, phone calls, public meetings, virtual one-on-one meetings, emails, and updates on CPA's webpage. The webpage has included links to surveys and forms soliciting information about the community and stakeholders' project concerns. The goal of this outreach effort is to encourage the community to tell CPA what their needs are and to give feedback about the Resilience Plan, not only during the development of the document, but afterwards into the engineering/design and implementation phases.

2.2.1. Stakeholder Meetings

Hosting virtual meetings and webinars is one way of potentially increasing participation and input into the Resilience Plan, particularly regarding the stakeholders. The stakeholders, as defined previously, are those organizations such as regulatory agencies, landowners, and advisory groups that have a technical and financial interest in the project. Coordinating with these entities to meet all together in-person can be extremely difficult due to work schedules. As the implementation of the proposed resilience projects will be relying on stakeholder buy-in, and as the regulators input into the resilience approach is critical to establishing the projects as feasible, it was vitally important that our planning team was able to gather their input as efficiently as possible. Therefore, CPA engaged the stakeholders virtually. If the opportunity arises, or it becomes a necessity, CPAs team will meet with stakeholders in person, likely meeting with one organization at a time. Online meetings were held using platforms such as Microsoft Teams or Zoom and were recorded and transcribed.

The first stakeholder meeting was hosted virtually on August 30, 2024. The purpose of the meeting was to review the marina redevelopment Master Plan, introduce the stakeholders to the resilience planning effort, and discuss the goals and objectives of the engagement process. The structure of the meeting allowed for discussion and feedback from the group, which was generally positive. Some agency stakeholders did raise questions regarding permitting the prioritized projects, and if the dredging permits for the new marina have been obtained. Questions regarding the extent of the planning study area, and if upland areas, such as Turkey Creek would be included as potential project areas arose. Information shared included current permits issued for areas around the sandbar and existing marina. The stakeholders expressed their interest in the planning process and articulated their satisfaction with the direction CPA was headed with their resilience and redevelopment efforts.

A few stakeholders' one-on-one meetings occurred in the fall and winter of 2024 – 2025. CPA and the planning team spoke to:

- The Conneaut Creek Dredge Reclamation Facility
- The ODNR
- Canadian National
- Ashtabula Metro Parks
- Township Park

The intent of each meeting was to discuss the agency or organization specific needs, wants, resilience challenges, and potential solutions. In these meetings, the planning team was able to present to each stakeholder group potential nature-based projects that may have beneficial impacts on their resources of concern. No major project feasibility concerns arose during these meetings. During the Canadian National, Ashtabula Metro Parks, and Township Park calls, the planning team discussed various projects that are

now included in this Plan. During the ODNR call, some permitting challenges were mentioned, particularly in relation to restoration techniques to mitigate the impacts of bluff erosion. ODNR gave some excellent examples of similar resilience and restoration projects for the planning team to investigate and learn from. These projects included Ashtabula Harbor's wetland, Baltimore Harbor area, and the Euclid Connector Project.

The second stakeholder meeting was held on May 22, 2025, to review the progress made on the Plan since the first meeting. The meeting included a presentation and discussion on the progress of the Plan, an overview of the Plan, the proposed resilience projects, and how the projects will be evaluated for prioritization. A draft of the document was provided to the stakeholders for review and comment. The planning team specifically asked for input and feedback on the descriptions of each agency's regulatory process, the referenced plans and guidance documents, and the proposed projects. We also asked the stakeholders to provide the planning team with additional information and data that the plan may be missing. ODNR Division of Wildlife provided information about the importance of the Conneaut Harbor as stop #1 on the Lake Erie Birding Trail. The recognition of this existing natural assets importance to the public, tourists, the economy, and to the environment highlights the need to protect natural habitats, improve visitor infrastructure, and incorporate conservation-friendly design in any coastal resilience action.

During the meeting ODNR, Office of Coastal Management noted that there are towns within Ohio that have created shoreline Special Improvement Districts to help plan, organize, and fund shoreline protection and restoration projects. According to Section 1710.02 off the Ohio State Revised Code, "A special improvement district may be created within the boundaries of any one municipal corporation, any one township, or any combination of municipal corporations and townships within a single county, or counties that adjoin one another, for the purpose of developing and implementing plans for public improvements and public services that benefit the district. A district may be created by petition of the owners of real property within the proposed district, or by an existing qualified nonprofit corporation" (Ohio Revised Code 2023). The City of Conneaut engaged in this conversation and indicated that they would be interested in exploring the establishment of such a special district to help support landowners, business owners, and the City in funding shoreline protection projects.

A final stakeholder meeting, likely in combination with a public meeting, will be held in August 2025.

2.2.2. Community Engagement

The foundation of the engagement efforts has been, and will continue to be, virtual and in-person community meetings. Prior to, and during all meetings, the CPA distributed project information and surveys to collect quantitative data on stakeholder opinions, preferences, and concerns about the proposed resilience projects. The surveys were both paper form and virtual and will be designed to capture a range of perspectives about climate change, resilience, green design, and future economic development along the shore of Lake Erie in Conneaut. Various public meeting formats were used during the development of the Plan, including formal presentations, one-on-one and focus group meetings, online meetings, and town hall meetings.

Figure 13. Engagement at Public Meeting 1

The first public meeting was hosted on September 10, 2024, from 6:00 PM to 8:00 PM at the Conneaut Arts Center located at 1025 Buffalo Street, in Conneaut Ohio. More than 40 members of the public and community organizations attended including the Conneaut City Manager, City Council members, CPA's Board members, the Conneaut Harbor Master, and members of the Board of Commissioners for Township Park. A town hall style meeting kicked off the evening, giving participants the chance to review the Master Plan, talk directly to CPA and Board Members, and get to know the planning team. Later, a formal presentation was given to introduce the public to the resilience planning effort. MentiMeter, an online interactive presentation tool was used to engage the attendees and solicit feedback about the planning process. Following the presentation and a formal question and answer session, breakout groups were assembled. A member of the planning team led each breakout group in a focused discussion on the following topics: (1) Community Resilience Concerns; (2) What's Important to the Community, and; (3) Resilience Project Ideas. Team members rotated to the breakout group tables to ensure all participants had a chance to voice their opinions, concerns, and ideas as they related to each topic. After a quick break, the planning team presented the thoughts shared during each of the topic discussions with the room at large (Table 2). The meeting ended with sharing the Plan development schedule and providing the public with resources on how to keep in contact with the team to continue to stay involved in the project.

The meeting was recorded and can be viewed on CPA's website here (insert link). The overall feedback received during and after the meeting was positive, with nearly overwhelming support from the public. However, a few concerns were voiced, including the desire of fisherman to avoid estuary spawning areas for fish, particularly in the areas east of Conneaut Creek that are providing habitat for smallmouth bass, and for assurance that any projects proposed would not further exacerbate shoreline erosion for residents. A few community members expressed apprehensions that the larger redevelopment project and recreation focused projects would result in reduced availability of parking at the shoreline, increased traffic and unsafe traffic patterns, increased rates of pollution, and the potential for increased nighttime noise levels. There were also questions regarding the number of jobs that will be created with the redevelopment.

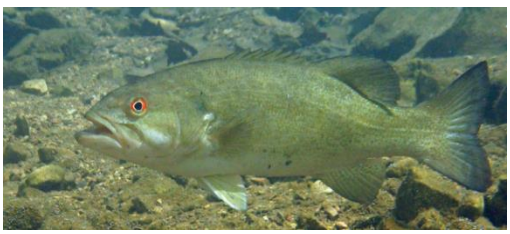


Figure 14. Smallmouth bass

Table 2. Breakout Session Feedback

Breakout Session Topic	Community Feedback
Resilience Concerns	Bluff Erosion
	Lake levels, low and high
	Increased storms and wave action, impacting the marina, and natural recreation areas
	Large population growth
	Stormwater and flooding with new development
What's Important to the Community	Lake Erie and the recreation opportunities it provides (sailing, fishing, etc.).
	Fishing in Conneaut Creek
	The beach area along Lake Erie
	Township Park
	Birding and photography

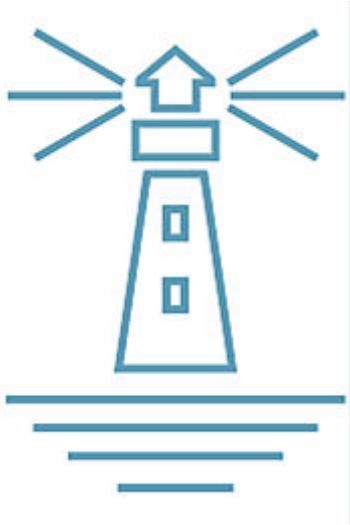
Breakout Session Topic	Community Feedback
	Protecting the shoreline and natural recreation areas
	The people of Conneaut and sustainable growth
	The view of the sunset
Resilience Project Ideas	Additional birding sites via boardwalk or ecological restoration project(s).
	New parking areas and projects that will address increased traffic
	A sandbar, island, or living shoreline to protect the marina and fishing boats from waves
	Invasive species management to help support wildlife
	Moving proposed commercial development uphill of Naylor Drive
	Adding family friendly development to the shoreline such as a splash pad, boardwalks with interpretive signage, etc.
	Educational opportunities along the shore, such as a boating safety program or signage

Beginning in November 2024, CPA and the planning team hosted various one-on-one meetings with community organizations and residents to further investigate similar resilience projects, discuss personal experiences with natural hazards, brainstorm project ideas, and get input into the plan. During this time, CPA and the planning team spoke to the Cleveland Metroparks about the Cleveland Harbor Eastern Embayment Resilience Strategy (CHEERS) and the Conneaut boat captains. A one-on-one meeting with a few residents who live along the Lake Erie Shoreline, west of Conneaut Harbor occurred on June 9th. On the call, the residents described the erosion occurring on their property, with one landowner noting that their property has subsided by approximately 22 feet in the last 8 years. Discussions regarding the possible causes of erosion, including anecdotal information on surface water runoff from neighboring properties south of Lake Road, resulted in an acknowledgement that site specific surveys and data collection will be needed. The planning team is anticipating a residential site visit on June 26th to various properties north of Lake Road to document and discuss bluff erosion. Additional one-on-one meetings will continue to be scheduled throughout the drafting of this plan, as residents express interest.

The second public engagement event is scheduled to take place on June 25th in Township Park. Information on the second public meeting will be updated for the draft final version of the document, anticipated in August 2025.

2.3. Stakeholder and Community Recommendations

Take aways from the engagement activities conducted for this Plan are wide ranging, but are generally positive, with community and stakeholders supporting the resilience work associated with the redevelopment plan. (this text will be finalized after the next series of public and stakeholder meetings and input).



Chapter 3. Achieving Resilience

3. Achieving Resilience

To achieve a resilient Conneaut, CPA is following the U.S. Climate Resilience Toolkit's steps to resilience framework which "encompasses the team building, data gathering, and decision making it takes for a local climate champion and a team of engaged community members to enhance their resilience to climate-related impacts" (U.S. Federal Government 2024) (Figure 15). The vision of this Plan is for the CPA, as a steward of the local economy and environment, to collaborate with the community of Conneaut to help residents learn about their local climate hazards, identify their most pressing climate-related issues, and work together to develop an equitable climate resilience plan. Creating a community driven Plan and prioritizing resilience projects endorsed by local residents and stakeholders will improve access to future funding and builds social cohesion and local capacity. Grantmakers, government agencies, and policymakers often favor or require demonstrated community support for projects that request design, permitting, and implementation funding, making it easier to secure future implementation dollars. The process of collaboration and shared decision-making also strengthens community relationships, trust, and capacity to tackle future challenges collectively.

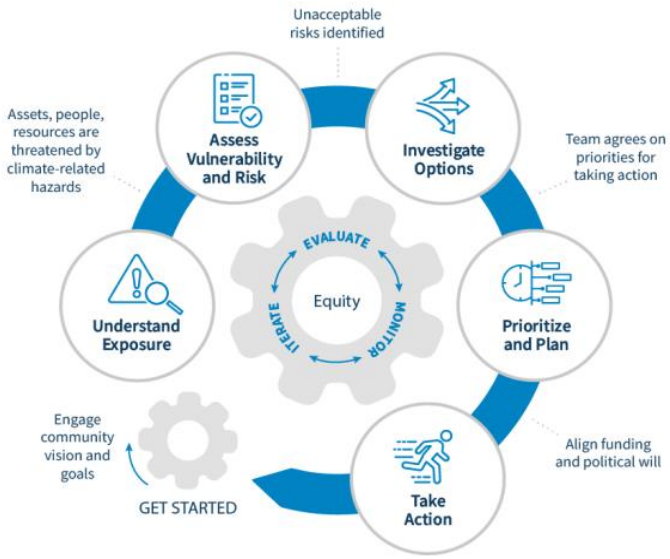


Figure 15. U.S. Climate Resilience Toolkit

The Conneaut Coastal Resilience Plan is intended to be a living document, with future updates encouraged. Impacts of climate-related risks and natural disasters change over time, as do demographics, economic drivers, and environmental conditions. The Plan is structured to adapt to these changes over time. In addition, as CPA and others "take action" (i.e., plan, permit, and implement) on the prioritized projects outlined in this Plan, other community vetted projects should be added.

Achieving resilience through ecological restoration and nature-based design projects necessitates thorough consideration of both community needs and ecological function. Factors essential for realizing coastal resilience, aside from engagement, include the current and projected environmental conditions as well as regulatory compliance and permitting. The planning team also reviewed current and historical resilience efforts to obtain valuable insights, lessons learned, and practical guidance in the pursuit of a resilient Conneaut. Additionally, these resilience efforts have provided the team with insights into effective resilience strategies and actions that can be used in Conneaut that successfully address the impacts of climate change.

3.1. Existing and Future Environmental Conditions

The Great Lakes are experiencing the repercussions of a changing climate, prompting renewed focus on the restoration and protection of the United States' largest freshwater system. In September 2022, Great Lakes Integrated Sciences and Assessments (GLISA) published a report detailing the impacts of climate change within the Erie region, including increased precipitation, rising temperatures, and reduced ice coverage. These changes have triggered a "domino effect" of impacts that not only affect the region but also the community of Conneaut (Channell *et al.* 2022).

3.1.1. Regional Climate Conditions

The Great Lakes region is experiencing an increase in annual precipitation as a result of climate change. The warmer air and surface temperatures contribute to higher evaporation rates, which in turn lead to greater cloud formation and more intense precipitation events and storms (Dietz *et al.* 2011; Sinha *et al.* 2023). Several Great Lake coastal communities have already experienced the effects of such storm events caused by increased precipitation. Erosion, exacerbated by heightened precipitation and more severe storms, has started to consume shoreline communities, resulting in the loss of residential properties, commercial developments, and formerly cherished public beaches. Current models predict 7% greater average rainfall intensity per degree of surface warming in the Great Lakes region (d'Orgeville *et al.* 2014; Sinha *et al.* 2023). With increased variability and intensity of precipitation, intermittent periods of flooding and drought will become both more frequent and severe (Wuebbles *et al.*, 2019; Sinha *et al.* 2023).

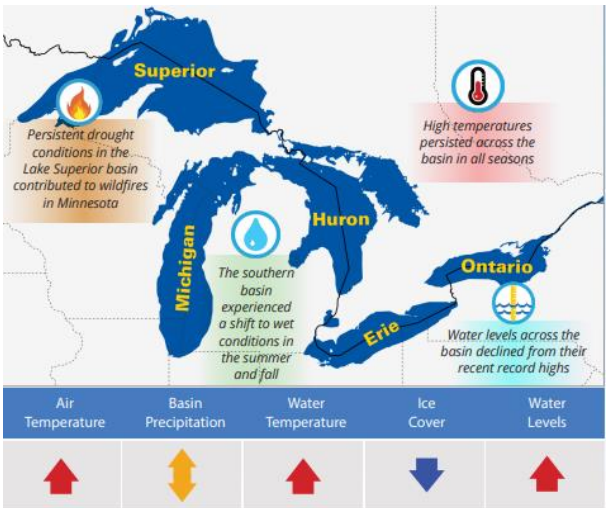


Figure 16. 2021 Annual Climate Trends and Impacts Summary for the Great Lake Basin

Air and surface water temperatures within the Great Lakes Region are also anticipated to rise. Currently, the average annual air temperature is 1.6°F higher than historical averages, which is higher than the overall change of 1.2°F over the contiguous United States for the same time period (USGCRP 2018). The average air temperature within the Great Lakes Basin is projected to continue increasing, reaching 5-6°F higher in the northern region and 4-5°F higher in the southern region (Wuebbles *et al.,* 2019). Warmer air and water temperatures cause the offset of critical seasonal cues, such as the delayed onset of winter and the early start of spring, both affecting the decline of ice coverage and lake stratification (Anderson *et al.* 2021). Unpredictable weather conditions and drivers (such as cold arctic air blasts) are still at play and able produce winters of extreme cold though these anomalies are predicted to become less extreme and less frequent.[10]

Overall, significant variability in ice coverage throughout the Great Lakes Region is anticipated. This variability can have both economic implications for shipping and navigation, and environmental impacts on lake ecosystems. Reduced ice coverage can increase the vulnerability of specific fish and wetland species that rely on ice for protection. While it may benefit the shipping industry by extending its operational period, it could negatively affect winter tourism activities and associated revenue for the surrounding region (Channell *et al.* 2022). Additionally, reduced ice coverage can expose shorelines, making them more susceptible to erosion during high wind and wave events associated with winter storms (Channell *et al.* 2022). During winter under icy conditions, the colder layers of lake water stratify into distinct levels with minimal mixing. In spring, seasonal warming triggers the overturning process, promoting the exchange of nutrients across different layers. Early spring warming, a result of climate change, causes earlier and prolonged stratification (Channell *et al.* 2022). Increased stratification and rising water temperatures foster conditions that exacerbate the impacts of nutrient runoff from agricultural and urban development, leading to Harmful Algal Blooms (HABs), particularly in Lake Erie

[10] Photo Credit: GLISA from glisa.umich.edu

(GLISA 2025). HAB toxins create hazardous conditions for humans, fish, and wildlife, resulting in fish kills, beach closures, and loss of drinking water. For instance, in Toledo, OH, 500,000 residents lost access to potable water for 72 hours in 2014 due to HABs (Sinha *et al.* 2023).

While it is difficult to truly measure and determine whether lake level changes are a natural variation in the hydrological cycle, or due to the impacts of climate change, scientists expect lake levels to experience "smaller drops on average and the possibility of a small rise in lake levels by the end of this century" (Channell *et al.* 2022). Over the past few decades, Great Lakes water levels reached both record lows and highs, with Lakes Huron and Michigan most susceptible to water level shifts due to large basin size and drainage patterns (Wuebbles *et al.* 2019). When averaged over the past hundred years, water levels in Lakes Superior, Michigan, and Huron showed no significant change, unlike Lakes Erie and Ontario, whose water levels rose (EPA 2025b). Lake Erie is the shallowest of the Great Lakes based on its bathymetry, or depth. Over the past hundred years, average water levels have shown that lake levels are influenced by precipitation, ice cover, runoff, and evaporation. High water levels can lead to increased flooding events, which some urban areas may struggle to manage due to insufficient water capacity. Reliance on grey infrastructure results in stormwater runoff spreading across impervious surfaces, introducing pollutants back into the lake and contributing to HABs and the loss of native species. Extreme flooding events also impact coastal communities through erosion and property damage. Lake Erie, in particular, experiences significant shoreline loss due to flooding and extreme storm events.[11]

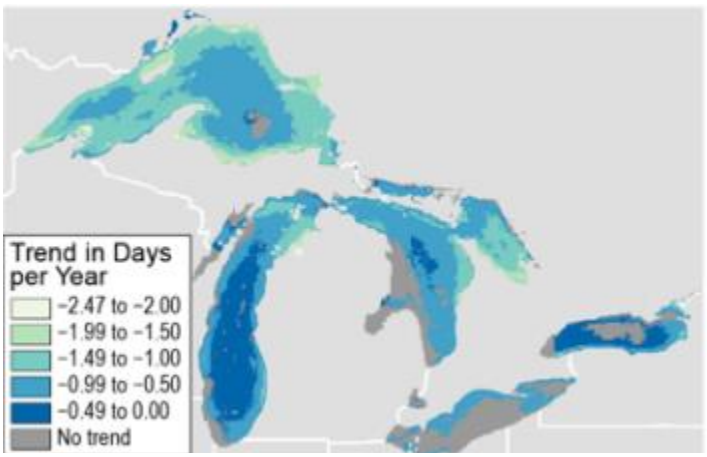


Figure 17. The Rate of Change in Ice Cover Duration from 1973 - 2013

The combination of rising lake levels, higher lake levels, more frequent and intense storms, and reductions in seasonal ice cover have increased the intensity and frequency of wave action along Lake Erie's shoreline. More intense storms, often fueled by warmer atmospheric and lake surface temperatures, generate more powerful winds that drive larger and more destructive waves across Lake Erie. This is especially problematic because Lake Erie is the shallowest of the Great Lakes, which means its waters respond more quickly to wind, creating steeper and more forceful waves (Wuebbles *et al.*, 2019). The combination of higher lake levels and stronger winds increases the energy with which waves hit the shoreline, accelerating erosion and damaging infrastructure. Higher lake levels exacerbate this issue. When lake levels rise, waves can reach farther inland and affect areas that were previously protected. The impact of these waves is not only a threat to natural coastal systems but also to communities, ports, and recreational areas that line the shore. Without adequate shoreline protection or resilience planning, many areas around Lake Erie are becoming increasingly exposed to wave-induced damage (Wuebbles *et al.*, 2019). As climate trends continue, these patterns of intensified wave action are expected to persist, underscoring the need for adaptive coastal management strategies.

[11] Photo Credit: Wuebbles *et al.* 2019 from climatehubs.usda.gov

3.1.2. Local Conditions

Conneaut, like many shoreline communities within the Great Lakes and along Lake Erie, experiences fluctuating water levels, decreased ice coverage, erosion, intensified storm events and increased wave action – all which affect fish and wildlife, the economy, and human health and safety. to a diverse array of ecosystems and habitats that support a rich tapestry of plant and animal life. These habitats range from dynamic coastal zones to tranquil upland areas, each playing a crucial role in the ecological health of the region. The diverse ecosystems of Conneaut provide essential services such as water filtration, habitat for wildlife, and opportunities for recreation and education. The area's rich biodiversity, including rare plant communities and a variety of wildlife species, underscores the importance of preserving these habitats for future generations.

Coastal Habitats & Infrastructure

The sandbar west of the marina presents a unique coastal marsh habitat that is uncommon along the shores of Lake Erie. Local residents highly value the diverse bird species that are drawn to the wetlands during migration and mating seasons, as well as the recreational and aesthetic benefits the wetland provides to the community. However, fluctuating lake levels and harmful algal blooms (HABs) pose significant threats to the wildlife population, recreational activities, and the hydrology of the wetland marsh. Additionally, the rise of invasive plant species threatens native vegetation. The loss of this habitat could result in a decrease in critical bird habitats, a reduction in ecotourism, and diminished recreational fishing opportunities.[12]

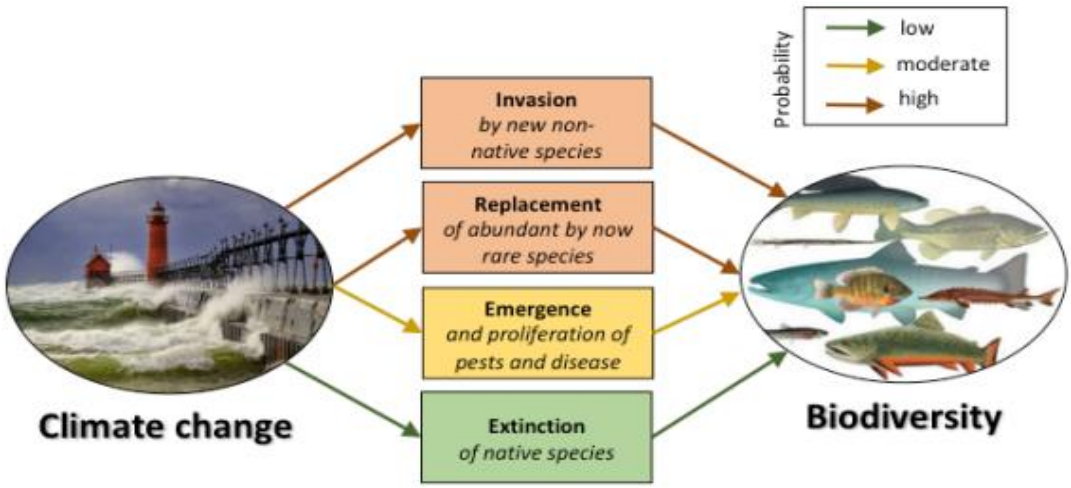


Figure 18. The impact of climate change on biodiversity in the Great Lakes.

The breakwaters that enclose the sandbar, marina, and port area on the east and west sides of the harbor mitigate the effects of wind-generated wave action, which is more pronounced elsewhere along the Erie shoreline. However, with rising lake levels, the breakwaters present other challenges to the CPA. While the breakwaters shield the marina and Marina Drive from most flooding events, the anticipated increase in water levels and the growing frequency of stronger storms pose a significant threat to the marina's infrastructure. Higher waves can result in damage to both the marina port and the breakwater walls themselves. Damage to Marina Drive can lead to the increased surface water runoff into the lake and surrounding waterways and wetlands.

[12] Photo Credit: Wuebbles *et. al* 2019 from climatehubs.usda.gov

When the breakwaters in Conneaut Harbor were constructed, they significantly altered the natural sediment transport dynamics along the Lake Erie shoreline (ODNR 2020a). Breakwaters are built to protect harbors and coastlines from wave action, but they also disrupt littoral drift - the natural movement of sand and sediment along the coast driven by wave action and currents (ODNR 2020a) (Figure 19).[13] In Conneaut, this disruption has created unintended geomorphological consequences that continue to shape the local shoreline. Specifically, the western breakwater has acted as a barrier to the eastward flow of sediment, trapping sand that would otherwise travel along the shoreline. As wave-driven undercurrents push sediment from west to east, the breakwater blocks this flow, leading to a stockpiling of sand on the west side, particularly at Conneaut Township Park Beach. Over time, this accumulation has caused the beach to grow outward, forming an artificially widened shoreline and expanding recreational space in that area.

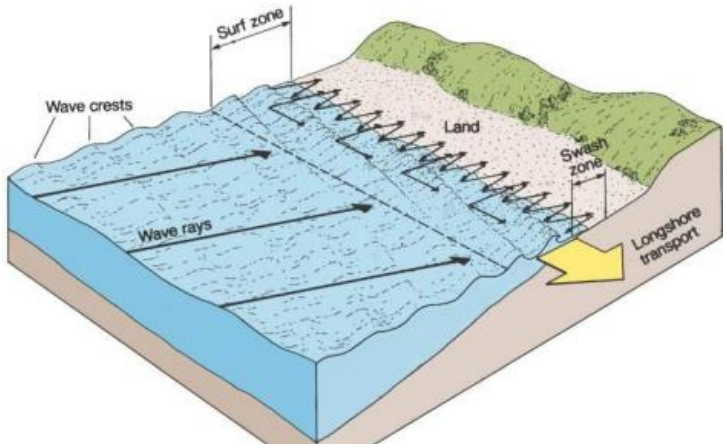


Figure 19. An example of Sediment Transport from Littoral Drift Process

However, this accumulation comes at a cost. East of the breakwater, sediment supply is cut off, leading to a process known as sediment starvation. Without a replenishing source of sand and sediment, the eastern shoreline begins to erode more rapidly. Natural wave energy continues to strike the shore, but without protective sediment, the coastline is worn away, increasing the risk of bluff failure, loss of habitat, and potential damage to infrastructure and private property. This imbalance in sediment distribution (excessive accumulation on one side and erosion on the other) is a common issue where hardened coastal structures like breakwaters are installed. In Conneaut's case, while the harbor has been stabilized and enhanced for navigation and commerce, it has also introduced a long-term ecological and shoreline management challenge that must be addressed through careful planning, potentially involving sediment bypassing, beach nourishment, or more nature-based design strategies to restore equilibrium to the coastal system.

The natural geology of the Lake Erie shoreline contributes to erosion. The shoreline east and west of the breakwater wall consists of bluffs up to 40 feet high, made of glacial till topped with clay, silt, and sand. These materials are inherently susceptible to erosion.[14] Wave action at the base of the bluff undercuts the structure, leading to slumping and collapse of the overlying material (ODNR 2020a).

Figure 20. A Bluff Along Lake Erie Shoreline, Ohio

[13] Photo Credit: Hunter College, Department of Geography and Environmental Science from geo.hunter.cuny.edu
[14] Photo Credit: Ohio Lake Erie Shore Erosion Management Plan from ohio.gov

Additionally, the presence of soil joints in the glacial till allows water to infiltrate and build up pressure, further destabilizing the bluff face. Erosion of these bluffs is part of a natural cycle; however, upland development such as residential dwellings, vegetation loss, and stormwater runoff are combining with natural erosion effects to exacerbate the process. With predictions of higher water levels, more significant storms generating increased waves, ongoing upland development, and the trapping of sand on the west side of the western breakwater wall, bluff erosion is anticipated to intensify, threatening the residential properties west of Conneaut harbor. Over the past 50+ years residential properties along these bluffs have been steadily losing shoreline. However, due to the impacts of climate change, the shoreline erosion rates have been increasing, particularly after the extraordinarily high lake levels of 2020. Some Conneaut residents have lost nearly 70 feet of bluff in a five-year period (Mongiovi 2023). Addressing this challenge requires a comprehensive approach that includes restoring vegetation, managing stormwater runoff, and considering the impacts of coastal structures like breakwaters on sediment dynamics.

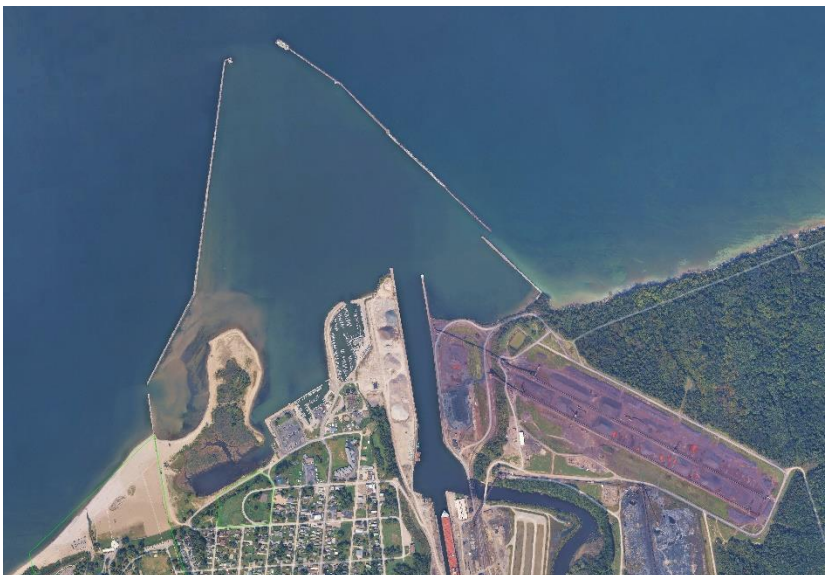


Figure 21. Conneaut's Coastal Habitats & Infrastructure

Upland Habitats & Infrastructure

Surface runoff and associated land-use factors in upland environments (areas located inland from the immediate shoreline) significantly influence the shoreline environment of Lake Erie. When upland habitats are vegetated and natural, they function as natural buffers to the shoreline, aiding in the reduction of sediment and nutrient transport and erosion. Vegetation stabilizes the shore, tree roots and native plants absorb rainwater, and upland wetlands and riparian habitats act as sponges, retaining excess surface water and minimizing flood surges. Conversely, when these habitats are cleared for development, agriculture, or roads, their protective functions are lost. Bare or paved surfaces increase runoff, leading to faster water flow, greater erosion, and increased nutrient and pollutant loading into the lake. Stormwater runoff carries sediment, fertilizers, pesticides, and other pollutants into tributaries and directly into Lake Erie. The increased volume and speed of this water escalate erosion at the shoreline, particularly where natural vegetation is absent.

Climate change is exacerbating these upland and shoreline dynamics. Increased precipitation results in heavier and more frequent storms, which lead to more runoff and flashier streams, contributing to erosion and flood damage. Rising lake levels cause wave action to reach further inland, undercutting bluffs and accelerating shoreline loss. More powerful storms generate larger waves and stronger currents, increasing physical pressure on shorelines already weakened by upland changes. Warmer temperatures can reduce snowpack and alter the timing of meltwater runoff, further affecting erosion patterns.

To safeguard the environment of Lake Erie's shoreline, it is crucial to manage both upland and coastal zones effectively and address the impacts of climate change. Mitigation strategies may include restoring and preserving native upland vegetation, reconnecting floodplains, and implementing green infrastructure to reduce and filter runoff. There are a few upland areas within the 6-mile study area of this Plan that are negatively impacting the Lake Erie shoreline that could benefit from these mitigation strategies, Kelsey's Run, the Lagoon Outfall, and Conneaut Creek.

Kelsey's Run

Conneaut's Township Park is a 60-acre lakeside park, established in 1926 and offers a variety of outdoor activities and natural beauty along the shores of Lake Erie. Kelsey's Run creek is situated between the park's west beach parking lot and the central pavilion and is crossed by a restored 1930s-era bridge, which spans a creek flowing from the east. This area is characterized by its shaded walking paths, picnic tables, and playgrounds, making it ideal for families and nature enthusiasts. The creek receives surface water runoff from various residential and commercial properties and roadways within the watershed and drains into Lake Erie at the sandy beach to the east of the parking lot at the end of Gibson Way (Figure 22). Localized runoff from Kelsey's run can negatively impact Lake Erie water quality through the transportation of pollutants such as heavy metals, nitrogen and phosphorus, and hydrocarbons (like oil and grease). Sediment transport is a known issue in Kelsey's Run, with heavy rainfall, snowmelt, and storms moving soils from the eroded and incised creek banks to the beach and into Lake Erie.

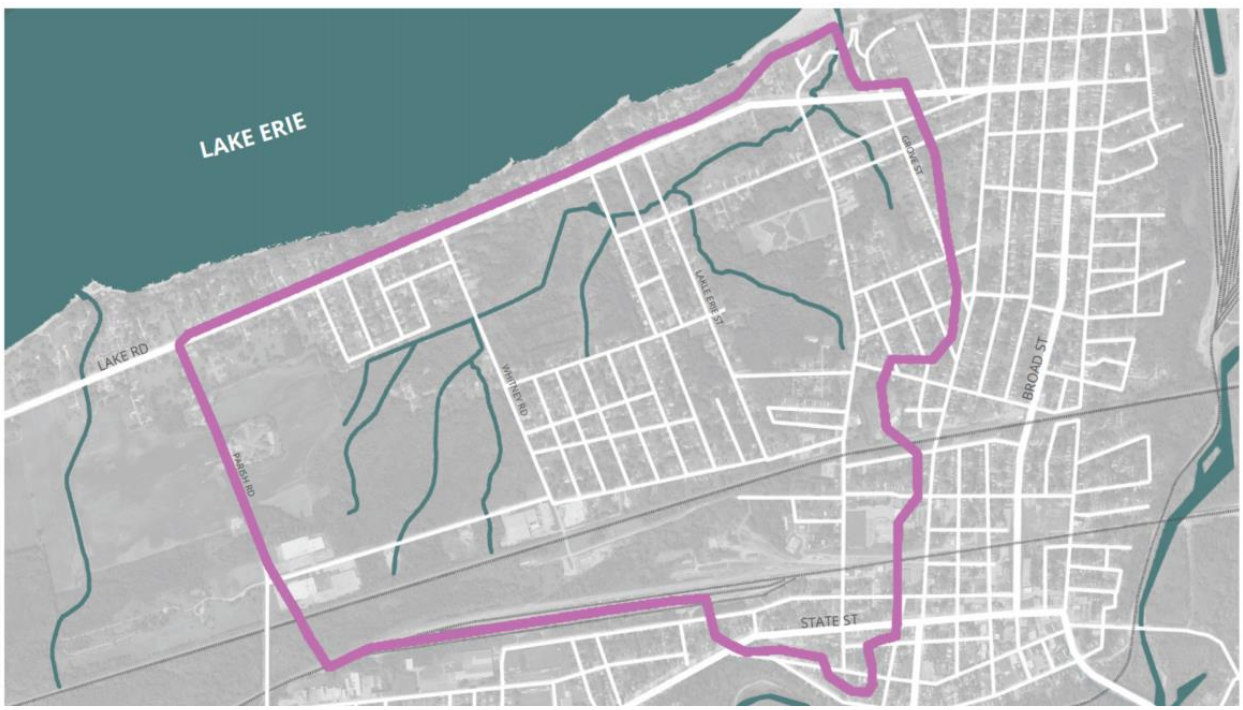


Figure 22. Kelsey's Run Watershed

Lagoon Outfall

Urban surface water runoff transports environmental contaminants, such as oil, grease, heavy metals, nutrients, pesticides, trash and debris, and sediment, creating negative impacts on the environment and human health. The effects from increased water pollution include eutrophication, where excess nutrients lead to algal blooms, depleting oxygen and causing fish kills and aquatic life toxicity where heavy metals and chemicals bioaccumulate in fish eventually causing the fish to become toxic to humans. Urban runoff

also increases the risk of waterborne pathogens which can cause gastrointestinal illness and skin irritations.

The primary collector of urban runoff within the town of Conneaut is the stormwater outfall that empties into the Lake Erie Lagoon, located north of Naylor Drive and southwest of Conneaut Harbor. The outfall collects runoff from urban development and discharges it directly into the lagoon. The lagoon is the future location of the marina expansion project, which is scheduled to begin construction in 2026. To accommodate the new boat slips, docks, and other infrastructure, the lagoon will be dredged; dredging permits from the USACE were approved in 2025. To help reduce the need for continual dredging, and the potential for harmful algal blooms, the volume and quality of the runoff needs to be addressed (Alliance for the Great Lakes). Various green infrastructure measures including bioretention practices and constructed wetlands can help slow down flow, retain and filter the water before it enters the lagoon.

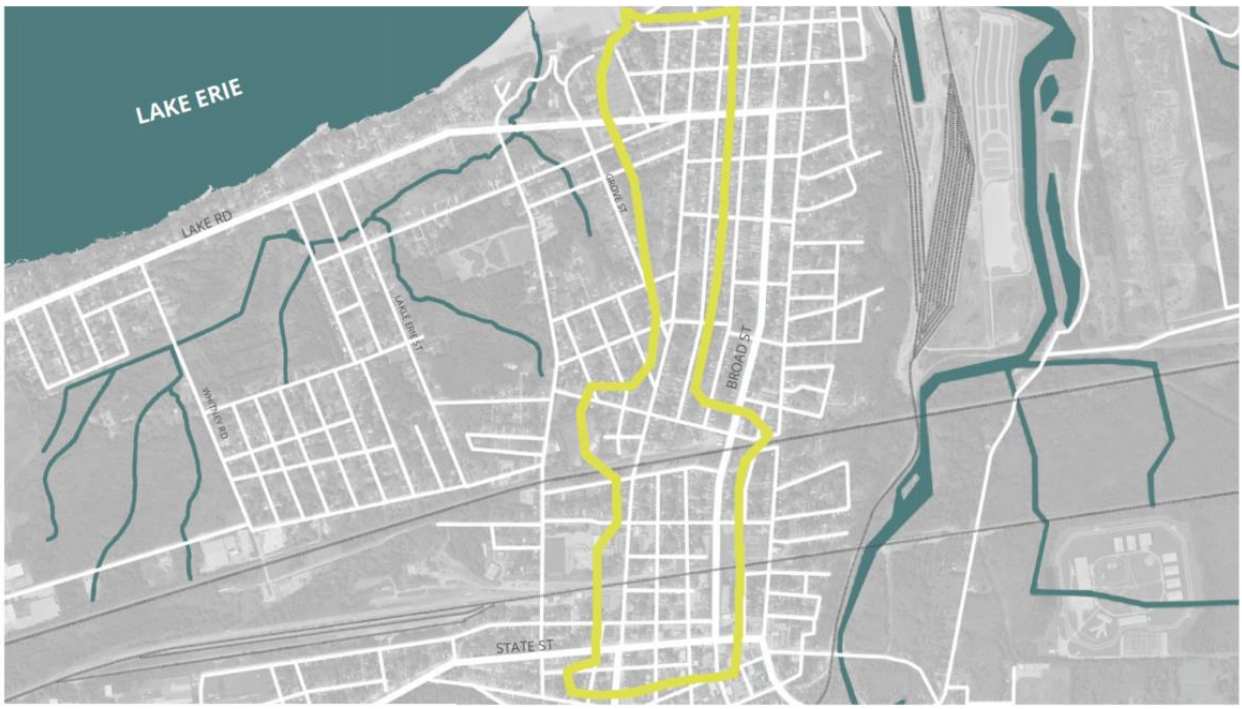


Figure 23. Lagoon Outfall Watershed

Conneaut Creek

Conneaut Creek, a 43.5-mile tributary of Lake Erie, flows through both Pennsylvania and Ohio, with its west branch reaching Lake Erie in Conneaut Harbor, east of the marina (Figure 24). The creek meanders through diverse landscapes, including rural woodlands, urban areas, and agricultural zones, offering a rich tapestry of habitats and recreational opportunities. Conneaut Creek has a mean annual flow volume of 323.46 cubic feet per second (cfs), draining approximately 493.41 kilometers squared (km^2) from

Figure 24. Conneaut Creek Wild and Scenic River

commercial, residential, and deciduous forested areas (EPA 2011). Conneaut Creek is renowned for its ecological diversity; A 21-mile stretch of the creek, from the Ohio-Pennsylvania border to the former Penn Central Railroad bridge in Conneaut, Ohio has been designated as a State Wild and Scenic River in 2005 (ODNR n.d.). [15] The stream corridor supports 78 fish species and 32 species of amphibians and reptiles. The watershed is home to more than 30 unique plant communities, many of which are listed as threatened or endangered. The creek's shale streambed and varying flow conditions create ideal habitats for a range of aquatic life (ODNR n.d.). The creek provides a variety of recreational opportunities for Conneaut residents and surrounding communities including fishing, canoeing and kayaking, wildlife viewing, birding, and photography. Despite its ecological significance, Conneaut Creek faces several environmental issues including water quality degradation from upstream pollutant sources such as leaking septic tanks and waste inflows from commercial infrastructure and sediment transport and turbidity from erosion.

Historical Conneaut Habitat

The Lake Erie basin was formed during the last Ice Age, as the Laurentide Ice Sheet advanced and retreated across northern Ohio (ODNR 2020b). Several glaciations produced a series of beach ridges that are several miles from the lake's current borders, and glacial till and deposits formed the ridges that would become Lake Erie's coastline. Meltwater flow from glacial melt roughly 12,000 years ago filled the basin and formed Lake Erie, while erosion from this flow formed Conneaut Creek. The glacial activity that formed Conneaut and the surrounding region's terrain created lake plains and moraines, with poorly drained soil near the lakeshore and better-drained upland soil further inland (ONDR 2020b).

Prior to European settlement, Lake Erie's lakeshore supported coastal marshes, wet prairies, and bluffs and beach ridges populated by sedges, rushes, and hardy shrubs such as willows and dogwoods. Further inland, the rolling hills and valleys supported the growth of beech-maple and oak-hickory forests while more open areas were suited to the development of the mesic prairie ecosystems that are typical across the Great Plains. Conneaut Creek, Turkey Creek, and the other regional tributaries draining into Lake Erie supported riparian zones and coastal wetlands that provided habitat for amphibians and migratory birds, as well as aquatic species.

As European settlement in the Conneaut area progressed throughout the late 18th and early 19th centuries, land was cleared for agriculture and industry as forests were logged for timber and fuel. Wetlands were drained, prairies were converted to cropland, and the contiguous old growth forests became fragmented. Conneaut's position on the lake as a hub for shipping and trade, as well as the development of the railroads, further accelerated deforestation and the degradation of the health of the region's wetlands and aquatic ecosystems.

[15] Photo Caption: Ohio Department of Natural Resources from ohiodnr.gov

3.2. Regulatory Environment

The Lake Erie coastal zone has multiple stakeholder interests and resource responsibility intertwined. As such, all project development within the Lake Erie coastal zone requires adherence to federal, state, and local environmental permitting through multiple regulatory agencies to ensure alignment with all approved management policies. Restoration projects aimed at achieving resilience in the shoreline and open water environments of Lake Erie will be under the regulatory authority of the USACE, ODNR, Ohio Environmental Protection Agency (OEPA), and Ashtabula County. While the permitting needs will be determined on a project-by-project basis, generally, the following permits will likely be required.

3.2.1. Federal Permitting

The most common federal permits for coastal resilience projects are administered by the USACE. The USACE is authorized to review projects that are connected to navigation channel dredging material use in habitat restoration (Section 216 of the Rivers and Harbors Act (RHA) of 1970404(b)(1) of the Clean Water Act (CWA) of 1972, Section 1135 of the Water Resources Development Act (WRDA) of 1986, Section 206 of WRDA 1996, and Section 1122 of WRDA 2016, and Section 204 of WRDA 1992). However, depending on the project's activities, federal environmental compliance with the National Historic Preservation Act (NHPA) and the Endangered Species Act (ESA) may also be required. If there is a federal nexus to these projects, such as federal funding, potential impacts to federally listed species, etc., the projects will also need to complete an environmental assessment through the National Environmental Policy Act (NEPA).

Clean Water Act Section 404

Under Section 404(b)(1) of the Clean Water Act (CWA) of 1972, the USACE regulates the discharge of dredged or fill material into Waters of the United States (WOTUS). WOTUS can include such bodies of water as lakes, ponds, rivers, tributaries, and wetlands. Impacts to WOTUS are authorized under one or more standard permits, known as Nationwide Permits (NWPs), or an Individual 404 permit based on project activities and level of impacts.

NWPs are used to authorize minor activities that result in minimal impacts to WOTUS. If minimal impacts to WOTUS are anticipated for a project, each single and complete project may be authorized under a NWP. The actual permit issued would be dependent on the type of impact that is proposed. Pre-Construction Notification (PCN) to USACE may be required for NWP authorization, depending on the extent of impacts. If fill exceeds set thresholds of the applicable NWP (e.g., 0.5 acre loss of WOTUS), then an Individual 404 permit is required. NWPs are typically faster to obtain averaging between 3-6 months than an Individual permits which could average over a year or more to obtain. Individual 404 permits would also require alternative analyses and include a public comment period.

National Environmental Policy Act

The National Environmental Policy Act of 1969, as amended (NEPA, 42 USC §§ 4321 - 4370h) is a foundational U.S. environmental law that requires federal agencies to assess the environmental impacts of federal actions before making decisions. Its core purpose is to ensure that environmental factors are considered alongside economic and technical factors in federal planning and decision-making. It is generally triggered by the involvement of federal funding, permits, or lands. NEPA established the requirement for Environmental Assessments (EAs) and more detailed Environmental Impact Statements (EISs) for major federal actions that may significantly affect the environment. Some federal actions that are determined to not have significant effects on the human environment can be categorically excluded from detailed analysis. NEPA also mandates public participation and interagency coordination, making it a critical tool for transparency and accountability.

The level of NEPA analysis will vary project by project, depending on the funding source (federal or nonfederal), the proposed project actions (dredging, riparian plantings, herbicide use for removal of invasive species, etc.), and the anticipated impacts to environmental resources (i.e., temporary reduction in spawning habitat, removal of invasive plant species in bird nesting habitat, extensive earth work to reconnect a floodplain, etc.). The CPA or other project proponent (such as the City, Ashtabula Metro Parks, etc.) will work with the lead federal agency - the federal agency that supervises the preparation of the environmental document and coordinates with other federal, state, tribal, and local agencies – on the environmental analysis.

National Historic Preservation Act

The 1966 National Historic Preservation Act (NHPA) established protections for historic structures and sites, including archaeological sites, within the United States. The National Register of Historic Places (NRHP) is the official list of districts, sites, structures/buildings, and objects that are significant in federal, state, or local history. Under Section 106 of the NHPA, State Historic Preservation Offices (SHPOs) are required to review potential impacts to historic resources listed on the NRHP when project activities have a federal nexus (i.e., federal funding, federal permitting including a NWP from USACE, or other federal authorization). All projects that involve ground disturbing activities and have a federal nexus (e.g., are on federal lands, use federal funds, or require a federal permit), will be required to comply with the NHPA. Compliance with the NHPA entails several steps: (1) Determining the Area of Potential Effects (APE), which constitutes the geographical area where the project may have direct or indirect impacts on cultural and historic resources; (2) Consulting with the State Historic Preservation Office (SHPO) and any Tribal Historic Preservation Offices (THPOs); (3) Identifying historic properties that are listed or may be eligible for listing on the National Register of Historic Places (NRHP); (4) Evaluating the project's effects on these cultural and historic resources; and, (5) Devising strategies to avoid, minimize, or mitigate any adverse effects.

Endangered Species Act

The Endangered Species Act of 1973 (ESA, 16 Unites States Code [USC] §1531-1544) authorizes the USFWS (while working cooperatively with States) to identify, list, and monitor qualifying species as endangered and threatened.[16] Species that are designated as either endangered or threatened are afforded protection from possession, sale, transport, and take. The definition of take is "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" including "incidental take" or significant habitat modification.

Figure 25. Great Lakes Piping Plover Adult and Chick.

ESA Section 7(a)(1) or Section 10(a)(1) consultation could be required depending on a federal nexus. ESA Section 7(a)(1) consultation would likely require a biological assessment and receipt of a biological opinion from the USFWS. The responsibly of Section 7 consultation fall with the lead federal agency reviewing the project. For example, if a project requires a NWP, it is the responsibility of USACE to coordinate with USFWS to determine that project activities will not have an adverse effect on threatened and endangered species of their habitats. However, project owners can initiate informal consultation with USFWS to determine potential avoidance and mitigation measures to expedite the Section 7 review process. If impacts to threatened and endangered species cannot be avoided, an Incidental Take Permit

[16] Photo Credit John Doskoch from Audubon.org

(ITP) under Section 10(a)(1) of the ESA might be required. The issuance of an ITP also requires the development of a Habitat Conservation Plan.

Bald and Golden Eagle Protection Act

Under authority of the Bald and Golden Eagle Protection Act (BGEPA, 16 USC 668–668d), bald eagles (*Haliaeetus leucocephalus*) and golden eagles (*Aquila chrysaetos*) are afforded legal protections.[17] The BGEPA prohibits the take, sale, purchase, barter, offer of sale, transport, export or import, at any time or in any manner of any bald or golden eagle, alive or dead, or any part, nest, or egg thereof. The BGEPA also expands the common law scope of "take"—to include "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb," and includes criminal and civil penalties for violating the statute (see 16 USC 668). The USFWS further defined the term "disturb" as agitating or bothering an eagle to a degree that causes, or is likely to cause, injury, or either a decrease in productivity or nest abandonment by substantially interfering with normal breeding, feeding, or sheltering behavior. The BGEPA specifies that violations must occur "knowingly, or with wanton disregard for this act."

Figure 26. Bald Eagle

Priority resilience projects identified in this Plan are unlikely to impact bald and golden eagles. While bald eagles have been observed in the area, most recently in May 2025, the proposed actions of the prioritized projects should not directly affect raptor species (ebird 2021). However, indirect impacts such as construction equipment noise may occur, that would disturb nesting birds, including eagles. Prior to any construction, a nesting bird survey would be conducted to determine if mitigation measures such as creation of buffer zones would be necessary.

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) integrates and implements four international treaties that provide for the protection of migratory birds against hunters and poachers. The MBTA prohibits "the taking, killing, possession, transportation, import and export of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior." (16 USC § 703; 1918). The word "take" is defined by regulation as "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect," (50 Code of Federal Regulations [CFR] § 10.12; 1973). The USFWS maintains a list of all species protected by the MBTA at 50 CFR § 10.13 (1973). This list includes over 1,000 species of migratory birds, including eagles and other raptors, waterfowl, shorebirds, seabirds, wading birds, and passerines.

There is no permitting authority under the MBTA and, as such, no way to obtain permit coverage for incidental take of MBTA-protected species. The primary means of compliance with the MBTA is through avoidance and minimization measures. Although the Project could impact suitable nesting habitat for some migratory bird species, certain actions—such as clearing vegetation outside of the breeding season

[17] Photo Credit: Michael Kullen from audubongreatlakes instagram

and implementing an environmental education training program including species identification placards or educational posters—could help minimize risks to migratory birds.

3.2.2. State Permitting

The agencies that are often involved in permitting resilience and environmental restoration projects in Ohio are the Ohio Environmental Protection Agency (OEPA) and the Ohio Department of Natural Resources (ODNR). The OEPA is a state dedicated to safeguarding public health and the environment by ensuring compliance with environmental laws and promoting environmental stewardship, with a mission statement to "protect the environment and public health by ensuring compliance with environmental laws and demonstrating leadership in environmental stewardship" (OEPA n.d.). Similarly, the ODNR is responsible for managing and conserving Ohio's natural resources through management of Ohio's state forests, monitoring Ohio's rivers, lakes and groundwater supplies, regulation of hunting, fishing trapping, operating state parks, regulating mineral and energy production, and through scientific research and data collection.

Clean Water Act Section 401 Water Quality Certification

Project activities requiring Section 404 authorization under either a NWP or an Individual Section 404 permit from USACE will also require Section 401 Water Quality Certification (WQC). Any prioritized project that will involve in-water and aquatic work (river restoration, bank stabilization, wetland restoration and creation, etc.) will require a 401 WQC. The OEPA administers the Section 401 program within the State of Ohio. The OEPA issued Section 401 WQC for NWPs. A proposed project that meets the general and activity-specific Section 401 WQC limitations and conditions will only require authorization from USACE; projects that exceed these conditions require application to OEPA for either a Director's Authorization or an Individual 401 WQC. Any project requiring an Individual 404 Permit will also require an Individual 401 Permit. The WQC for NWPs in Ohio set thresholds based on wetland categorization that reflects the functional quality of the wetland. Wetlands are categorized via completion of Ohio Rapid Assessment Method (ORAM) forms, which evaluate several metrics including wetland hydrology, size, and habitat alteration. Each metric is scored and then totaled to give a final ORAM score corresponding to an ORAM category (1 through 3). Category 1 wetlands represent low quality wetlands while Category 3 wetlands are high quality wetlands.

OEPA has additionally mapped certain high-quality watersheds where the applicability of the general WQC for the NWPs is limited for proposed stream impacts. Based on the OEPA 401 WQC for NWP Eligibility Map, watersheds within Ashtabula Count and surrounding the City of Conneaut, Ohio are protected watersheds that are listed as Possibly Eligible and Ineligible for WQC under the NWPs. Impacts to federally jurisdictional streams within a Possibly Eligible watershed that are determined to be high quality would require an Individual 401 WQC or a Director's Authorization from the OEPA. Stream quality is based on drainage area, pH measurements, and habitat assessment scores (i.e., Qualitative Habitat Evaluation Index [QHEI] or Headwater Habitat Evaluation Index [HHEI] scores). Impacts to streams within an Ineligible watershed require an Individual 401 WQC or a Director's Authorization from the OEPA, regardless of the stream quality.

OEPA Ohio Isolated Wetland Permits

The OEPA regulates all surface waters determined non-jurisdictional by the USACE, including isolated wetlands and perennial and intermittent streams. Any quantity of impacts to isolated wetlands will require authorization from the OEPA under a general or individual permit and an Approved Jurisdictional Determination (AJD) from the USACE. Temporary or permanent impacts up to 0.5 acres within Category 1 or Category 2 wetlands are eligible for coverage under a Level 1 Isolated Wetlands Permit. Temporary

or permanent impacts exceeding 0.5 acres of Category 1 and 2 wetlands and up to 3 acres of Category 2 wetlands may be authorized under a Level 2 Isolated Wetlands Permit. Any impacts to a Category 3 wetland or impacts exceeding 3 acres in a Category 2 wetland require authorization under a Level 3 Isolated Wetlands Permit.

ODNR Shore Structure Permit

A Shore Structure Permit is required from the ODNR prior to construction or modification of structures in Ohio along the Lake Erie Shoreline. Construction projects that require a permit include but are not limited to the construction of living shorelines, jetties, breakwaters, floating wetlands, etc. Several proposed projects in this Plan would require this permit. All shore structure permit applications would include infrastructure design plans prepared by a professional engineer, and would be reviewed by the ODNR. All resilience work requiring a shore structure permit would follow the Ohio Coastal Design Manual and policies related to shoreline management and erosion control from the ODNR Coastal Management Program.

ODNR Coastal Management Consistency Certification

Project activities along the shoreline must also adhere to the Coastal Zone Management Act of 1972 (CZMA). An Ohio Coastal Management Consistency Certification is required for projects that may affect Ohio's coastal resources or land and water uses, particularly along Lake Erie. This certification ensures that the proposed activity aligns with Ohio's Coastal Management Program (OCMP), which is designed to protect and manage the state's coastal environment. This certification would be applicable to any prioritized projects within this Plan that will seek a federal license or permit for an activity that may affect coastal resources (e.g., obtaining a USACE 404 and 401 certification), and/or if the project is funded using federal dollars.

Ohio Threatened and Endangered Species

Ohio Revised Code (ORC) 1531.25 charges the ODNR Division of Wildlife (DOW) to adopt rules restricting the taking or possessing of native wildlife threatened with statewide extirpation and to develop and periodically update a list of endangered species. Any wildlife species whose survival or recruitment within the state are in jeopardy and any species designated under the federal ESA are protected under Ohio state law. In Ashtabula County there are 50 state-listed wildlife species and 102 listed plant species (ODNR 2023a; ODNR 2023b). Prior to construction activities for any of the prioritized projects, a habitat assessment will be conducted to determine if there is suitable habitat for any threatened and endangered state and federal species. If suitable habitat is present, species specific surveys may be necessary, followed by mitigation measures to avoid harming or taking the species. Coordination with ODNR will occur on every project to complete an Environmental Review (ER) to provide comments on potential impacts and avoidance and mitigation measures

3.2.3 Local Permitting

Designing and implementing any of the prioritized projects listed in this Plan will require complying not only state and federal policies and permits, but also with local ordinances. Local permitting is particularly crucial as it ensures that the project aligns with the city's zoning regulations, comprehensive plans, and environmental standards. For projects within the Study Area, Ashtabula County and the City of Conneaut are the main governing bodies that will require permit coordination.

Building and Other Local Permits

Both Ashtabula County and the City of Conneaut regulate development within their respective boundaries. The Ashtabula County Boad of Commissioners and the Conneaut Planning & Zoning

Department should be contacted for specific required permits. Permits that may be required include a zoning certificate which evaluates the project's compliance with zoning ordinances and its impact on the community's development goals. Conditional use permits may also be required, especially if the project does not conform to the existing zoning regulations but are deemed beneficial for the community. Both the County and the City will be coordinated with during the design and implementation of the prioritized projects.

Floodplain Permitting

The Ohio Department of Natural Resources (ODNR) oversees the Floodplain Management Program for the Federal Emergency Management Agency (FEMA) regulatory floodways and 100-year floodplains, also known as Special Flood Hazard Areas (SFHAs). ODNR delegated responsibility for administering the program to local Floodplain Administrators. Within Ashtabula County, the Board of Commissioners, specifically through the Ashtabula County Engineer's Office, is the designated Floodplain Administrator. Under floodplain regulations, impacts to floodplains must be approved by the Board of Commissioners prior to work. Upland projects that may reconnect floodplains by grading and/or terracing riverine banks, may alter the floodplain, and would require coordination with the Board of Commissioners.

Local Stormwater Pollution Prevention Plan Review

The City of Conneaut's Codified Ordinances, particularly Chapter 931, address wastewater discharge and pretreatment standards. While these ordinances focus on wastewater management, they highlight the city's role in regulating discharges into its sewer systems. For construction projects that may impact stormwater runoff, local authorities may require permits and adherence to best management practices to prevent pollution. A Stormwater Pollution Prevention Plan (SWPPP) is necessary for construction projects disturbing one acre or more of land area. The SWPPP is implemented by the Project's operator (owner or contractor) and must be kept on the construction site at all times. The SWPPP must be prepared in accordance with the National Pollutant Discharge Elimination System (NPDES) regulations as established by the CWA and guided by the State of Ohio. NPDES was established under Section 402 of the CWA and establishes guidelines for point source discharges to WOTUS.

3.3. Local, State, Regional, and Federal Resilience Efforts

Coastal resilience efforts along Lake Erie, particularly in the Conneaut region, are structured through a multi-tiered approach, encompassing planning and implementation at local, state, regional, and federal levels. At the local level, municipal planning departments, parks and recreation departments, and port authorities play crucial roles. Municipal planning focuses on developing comprehensive plans, zoning ordinances, and building codes to mitigate coastal hazards and protect shorelines. These efforts include strategies for stormwater management, setback regulations, and shoreline protection, alongside the implementation of green infrastructure like rain gardens and permeable pavements to reduce runoff and enhance water quality. Parks and recreation departments contribute by implementing beach replenishment, dune restoration, and living shoreline protection for public beaches and recreational areas, while also providing vital public education on coastal hazards and resilience. Local port authorities manage dredging operations, ensuring the beneficial reuse of dredged materials for beach nourishment and habitat restoration, and implement projects to safeguard port infrastructure from coastal impacts.

Figure 27. ODNR Staff Monitoring

At the state level, Ohio's coastal resilience is fortified by the collaborative efforts of several key agencies. The ODNR is pivotal, managing coastal areas through programs focused on erosion control, water quality monitoring, and habitat restoration. [18] They also extend technical assistance and funding to local communities and implement protective measures in state parks and wildlife areas along the shoreline. The OEPA concentrates on safeguarding water quality, addressing issues like stormwater runoff, nonpoint source pollution, and harmful algal blooms. They provide funding, technical support, and enforce regulations to minimize shoreline hazards. Finally, the Ohio Sea Grant provides essential research, education, and outreach programs concerning Lake Erie's coastal issues, offering critical data, information, and resilience resources to policymakers, local governments, and businesses.

Regional collaboration is essential for effective coastal resilience along Lake Erie, and this is facilitated by several key entities. Regional planning commissions, where they exist, unite local governments to develop and execute comprehensive, long-term strategies for shoreline protection and resilience. The Great Lakes Commission fosters interstate cooperation, coordinating development, conservation, and restoration initiatives across the entire Great Lakes region. Furthermore, the Lake Erie Coastal Ohio Trail organization plays a vital role in promoting responsible recreational use of the shoreline while simultaneously educating the public about the trail, the ecological challenges facing Lake Erie, and the importance of coastal preservation.

Federal support for coastal resilience along Lake Erie is spearheaded by four key agencies.

- The USACE manages dredging, shoreline protection, and flood control, while also providing funding and technical expertise to local, regional, and state initiatives.
- The U.S. EPA enforces regulations, safeguards water quality, and funds coastal management programs, with a focus on addressing harmful algal blooms and invasive species.
- When catastrophic events occur, FEMA offers disaster preparedness, recovery, and flood mitigation assistance, and contributes to essential flood mapping.
- The National Oceanic and Atmospheric Administration (NOAA) provides critical scientific data, tools, and resources for coastal management, and funds programs like Sea Grant.

These interconnected federal agencies, working in concert with state, regional, and local entities, illustrate a comprehensive approach to bolstering the resilience of Lake Erie's shoreline.

The following projects illustrate some of the recent nature-based projects that have been planned and implemented with the Great Lakes and in Ohio. The planning team reviewed these projects, and even spoke with some of the project proponents, to learn more about the design and implementation process for each resilience effort. Information from these lessons learned discussions was utilized during the evaluation and prioritization of the projects described in Section 5.

3.3.1. Cleveland Harbor Eastern Embayment Resilience Study (CHEERS)

The Cleveland Harbor Eastern Embayment Resilience Study (CHEERS) exemplifies a forward-thinking approach to coastal protection and ecological enhancement. This initiative aims to repurpose dredged material to construct both land-based and aquatic structures, fostering diverse habitats and recreational spaces. By strategically designing onshore and offshore formations, CHEERS intends to create a haven for aquatic, wetland, and upland species, while simultaneously offering the community expanded opportunities for leisure activities on and near the water. To achieve these goals, the project incorporates

[18] Photo Credit: ODNR Nature-Based Shorelines, https://ohiodnr.gov/discover-and-learn/safety-conservation/about-ODNR/coastal-management/ohio-coastal-mgmt-program/nature-based-shorelines

three distinct shoreline designs, each tailored to mitigate wave energy, cultivate varied ecosystems, and provide accessible waterfront experiences for residents and visitors alike. This multi-faceted strategy underscores a commitment to both environmental sustainability and public enjoyment, demonstrating how infrastructure projects can simultaneously address coastal challenges and enrich community life. [19]

Figure 28. CHEERS View Illustration

3.3.2. Port Clinton Coastal Restoration Project

The Port Clinton Coastal Restoration Project, a $1.9 million initiative, restored 6 acres of coastal wetland and expanded 1.4 acres along Ohio's Lake Erie shoreline (Great Lakes Restoration Initiative 2024). Funded by the Great Lakes Restoration Initiative, the City of Port Clinton, and the Ohio Environmental Protection Agency, the project was led by the U.S. Army Corps of Engineers, Buffalo District. The project focused on restoring the wetland habitat by removing invasive species like phragmites from 12.2 acres and planting nearly 40,000 native plant species. This restoration enhances biodiversity, supports migratory birds, and improves water quality and local habitat. The project also boosts the local economy by enhancing recreational opportunities and strengthening shoreline resilience. The collaborative effort, involving federal, state, and local entities, serves as a model for future Great Lakes restoration projects.

3.3.3. Cleveland Lakefront Nature Preserve

Transforming a former landfill into a thriving ecosystem, the Cleveland Lakefront Nature Preserve exemplifies the beneficial reuse of dredged materials. Approximately 5.7 million cubic yards of sediment, repurposed from dredging operations, formed the foundation of this unique greenspace. Managed by the Cleveland-Cuyahoga County Port Authority, the preserve now provides diverse habitats, encompassing both forested and upland environments, all interwoven with recreational trails. This project highlights a

[19] Illustration: Cleveland Metroparks, https://www.clevelandmetroparks.com/about/planning-design/cheers-cleveland-harbor-eastern-embayment-resilience-strategy

successful strategy for environmental restoration and public access, turning a liability into an asset for both wildlife and the community.

3.3.4. Pointe Mouille Marsh Restoration Initiative

The Pointe Mouillee Marsh Restoration initiative in Michigan serves as a prime example of large-scale ecological revitalization along the Lake Erie coastline. Situated in the southeasternmost region of the state, this undertaking represents the most extensive freshwater marsh restoration effort ever undertaken in the United States. Through the efforts of the U.S. Army Corps of Engineers, a disposal island formed from dredged material has been constructed, yielding 450 acres of newly established wetlands and elevated terrain. Moreover, further plans envision the restoration of an additional 1,500 acres of wetland habitat, substantially enhancing the ecological integrity of the Lake Erie shoreline.[20]

Figure 29. Pointe Mouille Marsh Restoration

Once a location for dredged material storage, Windmill Bay in Michigan has undergone a remarkable transformation. Upon reaching its capacity, the site was meticulously sealed and planted, paving the way for an affluent residential and commercial enclave. This development mirrors the charming aesthetics of traditional Dutch villages, creating a unique community. Annually, the area bursts with vibrant colors, showcasing a profusion of tulips, and a genuine windmill, brought over from the Netherlands, stands a s a testament to its inspired design. This location proves that previous industrial sites can be repurposed for beneficial uses.

3.3.5. Sandusky Bay Initiative

The revitalization of Sandusky Bay is being driven by the comprehensive Sandusky Bay Initiative, a project aiming to rejuvenate over 1,000 acres of habitat within the bay's expansive 40,000-acre expanse. To date, this undertaking has successfully reinstated 50 acres of vital wetland ecosystems, coupled with efforts to restore riparian creeks, thereby reestablishing natural connections between these waterways and their floodplains. This enhanced connectivity facilitates more fluid water movement and promotes the settling of sediment. Future phases of the initiative prioritize continued habitat restoration, alongside the development of adaptable, nature-inspired shorelines. These innovative shorelines are designed to lessen the impact of wave energy, foster the establishment of wetlands, and provide crucial protection to shoreline infrastructures vulnerable to erosion.

3.4. Resilience Strategies

Resilience strategies focus on enhancing the ability of systems—whether they are urban, natural, or mixed environments—to withstand, adapt to, and recover from the impacts of environmental stresses, such as climate change, extreme weather events, or natural disasters. These strategies prioritize the use of natural systems, ecosystem services, and sustainable practices to address vulnerabilities and create more sustainable, adaptable, and self-sustaining solutions. The following are common resilience strategies for

[20] Photo Credit: Michigan Department of Natural Resources, https://content.govdelivery.com/accounts/MIDNR/bulletins/25d3caa

protecting and improving coastal environments. The planning team considered and evaluated these strategies to assess their suitability and effectiveness in addressing the challenges and impacts faced in Conneaut.

3.4.1. Nature-based Shoreline Restoration

Nature-based shoreline restoration refers to the process of using natural or nature-inspired techniques to restore and protect coastal and shoreline ecosystems. This approach focuses on leveraging the inherent resilience and functionality of natural systems—such as wetlands, mangroves, seagrasses, salt marshes, sand dunes, and riparian vegetation—to stabilize shorelines, reduce erosion, improve water quality, and provide habitat for wildlife, while enhancing the overall ecological health of the area. Unlike traditional engineering approaches (e.g., seawalls or concrete barriers), nature-based shoreline restoration seeks to work with nature rather than against it.[21] The goal is to use ecological processes to address coastal challenges such as sea-level rise, storm surges, erosion, and flooding, while also providing additional benefits such as biodiversity enhancement, carbon sequestration, and recreational opportunities.

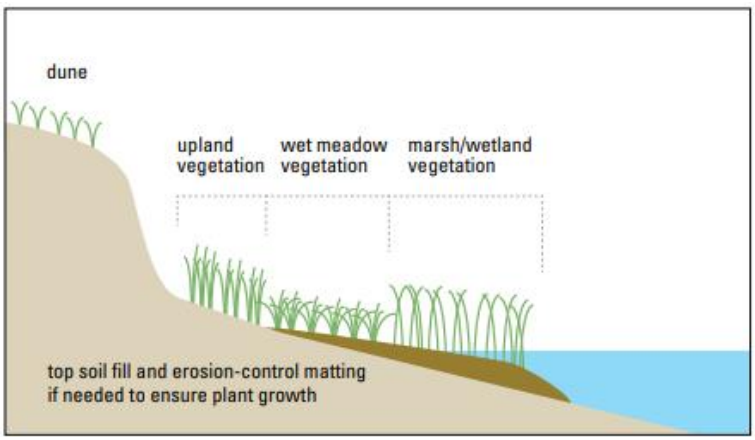


Figure 30. Native Vegetation Erosion Control Method

There are a few types of nature-based shoreline restoration infrastructure types, green and gray/green. Green infrastructure, relying solely or mostly on vegetation and is primarily suitable for low to medium wave energy environments, whereas gray/green (i.e. integrated traditional and nature-based) infrastructure is more appropriate in higher energy wave environments (NOAA 2015). Depending on the project site a mix of green and gray strategies may be possible.

Coastal Wetland Restoration

Coastal wetland restoration involves rehabilitating or recreating wetland ecosystems that have been degraded, drained, or lost due to urban development, agriculture, pollution, or invasive species. These wetlands are essential for maintaining the ecological health of the lake, as they provide habitat for wildlife, filter pollutants, reduce erosion, and buffer inland areas from flooding and storm surges. Key components of a coastal wetland restoration project that lead to long-term success include re-establishing natural hydrology, removing invasive species and planting native species, and incorporating buffer zones with native grasses and shrubs along the wetland to assist with filtering nutrients.

[21] Photo Credit: ODNR from Nature-Based Shoreline Options for the Great Lakes Coasts, Ohio.gov

The Great Lakes Science Center (GLSC) explored a variety of techniques for coastal wetland restoration in the Great Lakes that focused on hydrologic, sedimentation, chemical, and biological aspects of control (Wilcox *et al.* 1999). Hydrologic techniques are referenced for restoring hydrologic connections between diked and altered wetlands and the lakes, reestablishing water tables lowered by ditching, and reinstating natural fluctuations in lake levels of regulated lakes such as Superior and Ontario. Sediment control strategies include the management of sediment input from uplands, proper administration or removal of dams on tributary rivers, and the restoration of protective barrier beaches and sand spits. Chemical methods aim to reduce or eliminate contaminants from point and non-point sources through natural sediment remediation by biodegradation and chemical degradation, as well as active sediment remediation via removal or *in situ* treatment. Biological approaches encompass the control of non-target species, enhancement of target species populations, and improvement of habitat for target species (Wilcox *et al.* 1999). [22]

Figure 31. Before and After Wetland Restoration Site

Case studies of coastal restoration work include the Metzger Marsh in Lake Erie, located west of Toledo, Ohio. This project included the incorporation of a dike with a water control structure tower and efforts to revegetate and introduce native species. Cootes Paradise project, located in Canada was also cited as another successful model for wetland restoration using barriers for invasive species like the common carp, reduction of inflowing sediments and nutrients, naturalization of the shoreline, vegetation bank stimulation and protection, and careful vegetation management.

Beach Replenishment

Beach replenishment, also known as beach nourishment, is a coastal resilience strategy used to combat erosion, protect infrastructure, and maintain natural shorelines. It involves adding sand or sediment to eroded beaches to restore their natural form and function.[23] Though more commonly associated with ocean coastlines, beach replenishment is increasingly used in the Great Lakes, particularly along the shores of Lake Michigan, Lake Erie, and Lake Ontario, where erosion from high water levels and storms threatens property, ecosystems, and public access. Ultimately, beach nourishment widens a beach and advances the shoreline seaward.

Figure 32. Beach Replenishment Project Lake Erie

Beach nourishment projects are created to mimic natural beaches, allowing sand to shift in response to changing waves and water levels. Coastal engineers might place

[22] Photo Credit: United States Fish and Wildlife Service from fws.gov
[23] Photo Credit: Go Erie, goerie.com

beach fill as underwater mounds, directly on the beach, as dunes, or a combination of these methods. Once the sand is placed, it is gradually redistributed by natural processes affecting the beach system. Ultimately, the wider nourished beach, which slopes downward below the waterline, and the taller sand dunes protect the shore by acting as buffers (USACE 2007).

In addition to mitigating coastal erosion and protecting life and property through hurricane and storm damage reduction, beach nourishment projects can provide environmental, recreational, and aesthetic benefits. For example, nourishing and widening an eroding beach can (1) Protect threatened or endangered plants, (2) Preserve habitat behind dunes or adjacent to beaches, (3) Restore or create new nesting areas for shorebirds and spawning grounds for other species (USACE 2007). Beach nourishment projects can also result in wider shorelines for recreational activities such as fishing and boating and protecting infrastructure frequented by tourists. Healthy beaches are important to the travel and tourism industry and can contribute to local economies by increasing property values, rentals, retail sales, and demand for services.

Gray/Green Coastal Shore Protection Structures

The coastal shoreline is a dynamic zone shaped by natural forces and human interventions; it requires careful management to mitigate erosion and protect valuable land. Understanding the intricate coastal processes at play is paramount for effective shoreline protection. These processes, influenced by factors like marine climate, geology, weather, and human activities, dictate how shorelines respond to wave action and sediment transport. Sandy shorelines, for instance, are highly mobile, while glacial till bluffs, though initially resistant, don't recover naturally from erosion.

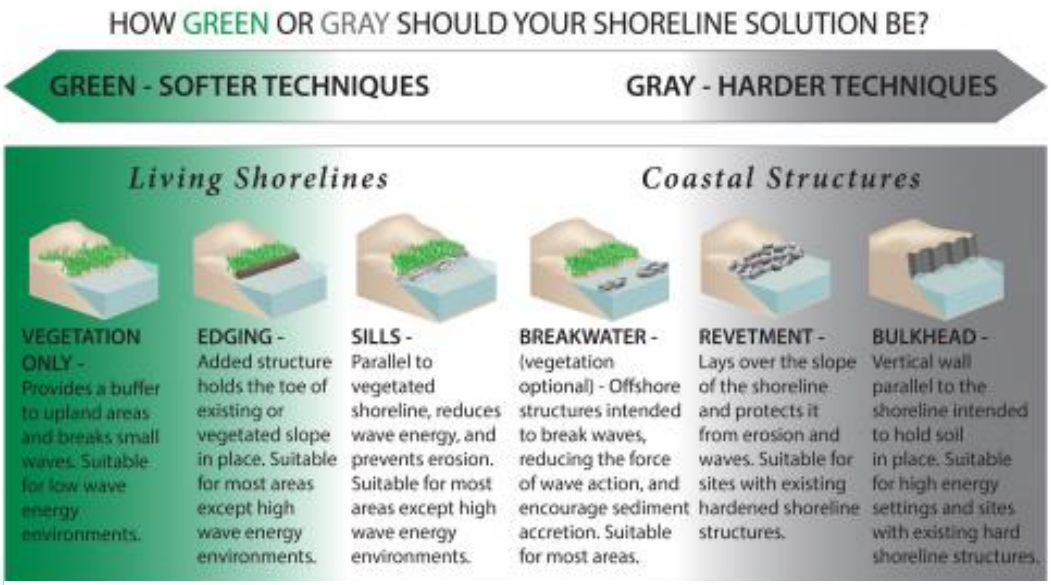


Figure 33. A Continuum of Green to Gray Shoreline Stabilization Techniques

The phenomenon of "sand starvation," where sand is lost faster than it's replenished, is a major concern, often exacerbated by both natural and artificial structures. To combat these challenges, various coastal protection structures are employed. Shore-parallel structures, such as rock rip-rap revetments and seawalls, protect the base of bluffs but can lead to beach narrowing. Shore-perpendicular structures, like groins and jetties, trap sand but can cause erosion down-drift. Offshore breakwaters reduce wave energy and promote beach growth, offering versatile protection. Each structure type has unique advantages and

disadvantages, requiring careful consideration of site-specific conditions.[24] Effective design and implementation of these structures rely on comprehensive monitoring, including sediment sampling, beach surveying, and wave measurements, as well as sophisticated modeling techniques. Coastal engineers, with their expertise in Great Lakes coastal processes, play a crucial role in ensuring that shoreline protection measures are both effective and sustainable, minimizing unintended consequences and preserving the integrity of the local ecosystem.

Bluff Protection Measures

The Great Lakes shoreline is shaped by a long history of glacial activity, leaving behind diverse soil types like clay, sand, and bedrock, each with varying erosion resistance. Clay bluffs are prone to landslides when wet, while sandy areas erode more gradually. Bedrock, though tougher, eventually succumbs to weathering.[25] This geological legacy also dictates the presence of natural defenses like beaches and underwater bars. Ongoing factors such as water flow, lake level changes, storms, and potential climate change further contribute to erosion. Furthermore, the placement of buildings along eroding shores initiates a "geo-time" clock, where erosion reduces the building's lifespan. Relocating structures inland resets this clock and restores property value.

Figure 34. Failing Bluff Along Lake Erie, PA Coastline

Lakebed erosion, particularly in areas with clay and glacial till shorelines, is a key driver of bluff and bank erosion in the Great Lakes. This underwater erosion, often invisible, dictates the rate of visible shoreline recession. As the lakebed erodes, it allows larger waves to reach the base of the bluffs, accelerating erosion at the toe of the slope and leading to further recession. If wave action alone erodes a shoreline, the remaining lake bottom creates a shallow barrier, which weakens incoming waves and protects the base of the land. Conversely, the lake floor itself can erode, particularly in softer rock formations. Unlike beaches, which can rebuild after storms, this underwater erosion is permanent. The fine particles released from these eroding lakebeds do not contribute to nearshore recovery; instead, they remain suspended and ultimately settle in the lake's deeper regions. The underwater erosion of Great Lakes lakebeds, while often subtle, occurs consistently and significantly impacts shoreline stability. Vertical erosion rates fluctuate, typically ranging from a few inches annually, with the most intense activity near the shore where wave turbulence is highest. This erosion, a slow but persistent process, can extend to considerable depths, and its rate is directly linked to the steepness of the lakebed slope. Steeper slopes experience faster erosion, resulting in a concave profile near the shore. Unlike surface erosion, lakebed erosion is not mitigated by low lake levels; instead, it's accelerated, leading to increased wave impact and toe erosion when water levels rise. This unseen erosion compromises shore protection structures, shortening their lifespan and subjecting them to greater wave forces. Furthermore, abrasive materials like sand and gravel, eroded from coastal slopes, enhance lakebed erosion through abrasion and impact. However, substantial deposits of these materials can act as a protective barrier, though the dynamic nature of sandbars means a significant thickness is required for effective protection.

[24] Photo Credit: NOAA 2015, climateactiontool.org
[25] Photo credit: Shamus Malone USGS.gov

Various methods to protect the eroding bluffs within the Great Lakes have been utilized and range from more large-scale involved projects to smaller, more simplified solutions. Examples of complex solutions include toe protection at the base of the bluff using riprap, stone revetments, and offshore breakwaters, and grading and terracing, which involves re-contouring the bluff, which can reduce slope steepness and improve stability. Less intensive solutions to protect bluffs include surface water management to reduce erosion (i.e., drainage controls, rain gardens, vegetated swales), and invasive species removal and native vegetation plantings to stabilize the soil and intercept rainfall.

Invasive Species Removal & Native Vegetation Plantings

Figure 35. Native Plantings - Port Clinton Coastal

THE ODNR has partnered with Office of Coastal Management, Division of Wildlife and Division of Geological Survey to identify causes of erosion within Ashtabula County in specific areas called reaches and compiled a list of recommendations based on each reach specific erosion issues (ODNR 2020a). In Conneaut reach ten, which is defined as Pennsylvania Avenue to the western breakwater of Conneaut Harbor, and reach twelve, which is defined as the southeastern Conneaut Harbor breakwater to the state line, identifying planting of native vegetation as a strategy against further erosion along the shoreline and bluffs. Encouraging growth of native vegetation along the bluff slope would aid in removing excess ground water and retaining soil strength, thereby reducing erosion. Due to the presence of ground and surface water in Conneaut harbor, the bluff along the shore is suitable for native vegetation growth (ODNR 2020a).[26] In addtion, the peninsula located in the marina could also benefit from invasive species removal and native vegetation restoration. Invasive species such as common reed (P*hragmites australis*), and purple loosestrife (*Lythrum salicaria*) can be replaced with native wetland and upland speices such as willows (*Salix* spp.), American beach grass (*Ammophila breviligulata*), and blushrush (*Scirpus* spp.).

Fish Habitat Structures

In the Great Lakes, a variety of fish habitat structures are used not only to support healthy aquatic ecosystems but also to contribute to coastal resilience. These structures provide critical shelter, spawning grounds, and nursery habitat for native fish species—while also playing a role in stabilizing shorelines, reducing erosion, and improving water quality. Many of these approaches are part of nature-based restoration projects that blend ecological enhancement with shoreline protection. Common fish habitat structures that also provide coastal resilience benefits include submerged wood debris, artificial fish shelters (i.e., reef balls), vegetated habitats (i.e., submerged aquatic vegetation), and reconnected backwater channels.[27] The Pennsylvania Department of Conservation of Natural Resources (DCNR) have previously implemented a series of artificial fish habitat structures in the Presque Isle Bay to improve fish populations and enhance fishing success.

Figure 36. Porcupine Cribs for Fish Habitat

[26] Photo Credit: USACE from army.mil

[27] Photo Credit: Save or Native Species, Inc. of Lake Erie Fishing Club from https://sonsoflakeerie.org/habitat.htm

Three types of structures, porcupine brush cribs, shallow water spawning structures, and stake tree structures were chosen to provide protection for fish and enhance spawning and nesting success (Ohio Sea Grant College Program 1997).

3.4.2. Open Water Green Infrastructure

Open water green infrastructure pertains to the application of natural or nature-based systems within open water environments—including lakes, bays, estuaries, and nearshore areas—to enhance coastal resilience. These methodologies utilize ecosystem functions to mitigate wave energy, decrease erosion, enhance water quality, and safeguard coastal habitats as well as human communities from the adverse effects of climate change, storm surges, and rising sea levels. Benefits to utilizing this type of coastal resilience strategy include wave attenuation, erosion control, habitat creation, and flood mitigation.

Living Shorelines

Living shorelines are a coastal resilience strategy utilized in the Great Lakes region to stabilize eroding shorelines, protect coastal infrastructure, and enhance natural habitat. Unlike traditional "gray" infrastructure such as seawalls or bulkheads, living shorelines employ natural materials—such as native plants, rocks, logs, and biodegradable fiber rolls (e.g., coir logs)—to absorb wave energy, reduce erosion, and support ecosystems. This method incorporates native vegetation, often combined with natural structural elements (e.g., rock sills, woody debris), to mimic or restore natural coastal processes like wave buffering and sediment trapping, while maintaining or improving the ecological connectivity between land and water. Benefits to living shorelines and numerous as compared to traditional hard gray infrastructure as illustrated in Table 3.

Table 3. Benefits of Living Shorelines

Living Shorelines	Hard Shorelines (e.g., seawalls)
Absorb wave energy and reduce erosion	Reflect wave energy, often increasing erosion nearby
Provide habitat and support biodiversity	Offer little to no habitat
Improve water quality through filtration	Can increase runoff and pollutant loading
Adapt to changing lake levels	May become ineffective with water level shifts
Typically cost-effective over the long term	Often expensive to build and maintain

NOAA encourages the use of living shorelines, green restoration, where possible and has provided guidance on determining whether an area would be suitable for such restoration (NOAA 2015; Figure 33). When considering the possibility of a living shoreline NOAA advises understanding the physical conditions at the site such as the amount of boat traffic that occurs along the shoreline or the extent, rate, and cause of the current erosion problem. Ecological factors to consider are the presence of valuable aquatic habitats or animals at the site, such as habitat used by federally threatened or endangered animal species or submerged aquatic vegetation beds (NOAA 2015).

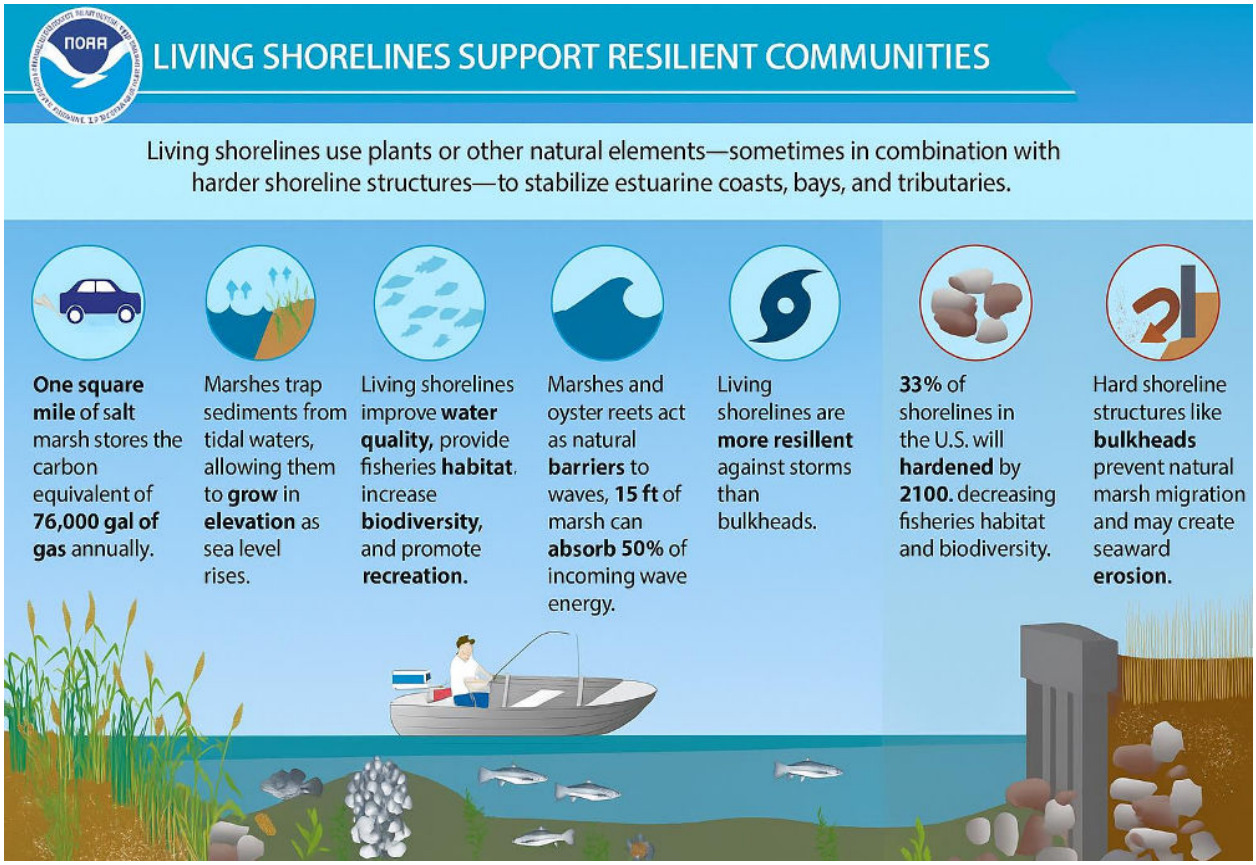


Figure 37. Living Shorelines and Resilient Communities

Floating Wetlands

Floating wetlands, also known as floating treatment wetlands (FTWs), are artificial platforms planted with vegetation that float on the surface of a waterbody (Figure 38).[28] These wetlands are a green infrastructure tool used to enhance water quality, provide wildlife habitat, and stabilize shoreline conditions, especially in urban or degraded coastal environments where natural wetlands have been lost. Floating wetlands consist of:

- A buoyant base, often made of recycled plastic or biodegradable materials,
- Native wetland plants (such as sedges, grasses, or rushes) planted into the mat,
- Roots that hang beneath the surface, creating a submerged network that interacts with the surrounding water.

Figure 38. A Cross-section Rendering of a Floating Wetland

These systems replicate some of the ecological functions of natural wetlands but are designed to float in open water or nearshore zones. The benefits of floating wetlands for coastal resilience are outlined in Table 4. In the Great Lakes, floating wetlands offer a flexible, cost-effective solution for enhancing

[28] Photo Credit: The National Aquarium, yale.edu

coastal resilience in urbanized or degraded waterfronts. By improving water quality, reducing erosion, and creating habitat, they help communities better adapt to environmental stressors such as stormwater pollution, climate change, and shoreline degradation—while reconnecting people with nature in the process.

Table 4. Benefits of Floating Wetlands

Function	Benefit
Nutrient absorption	Reduces algal blooms and improves water clarity
Habitat creation	Supports fish, birds, and pollinators
Erosion buffering	Helps protect vulnerable shorelines from minor wave and boat wake impacts
Urban retrofitting	Can be installed in constrained or developed shorelines
Climate adaptation	Increases resilience to flooding and water quality degradation

Constructed or Restored Reefs

Constructed or restored reefs in the Great Lakes are nature-based structures placed in nearshore waters to support native fish habitats, stabilize sediments, and reduce coastal erosion.[29] They blend ecological restoration with shoreline protection, enhancing coastal resilience against high lake levels, stronger storms, and habitat degradation due to climate change. These reefs can include artificial reefs, which are built with natural materials such as limestone, restored natural reefs, and structures placed in shallow or mid-depth waters to mimic the function of natural reef systems. These reefs are typically designed to enhance fish spawning, support benthic organisms, and improve ecosystem health, while also contributing to shoreline protection.

These reefs support coastal resilience through:

- Wave energy reduction – Reefs function as submerged barriers that attenuate wave action before it impacts the shoreline, thereby mitigating erosion. By decelerating waves, reefs contribute to increased sediment deposition, aiding in the restoration of nearshore areas.
- Sediment stabilization – Reef structures reduce water turbulence near the lakebed, helping keep sediments in place, improving water clarity and supporting aquatic vegetation, which further reinforces shoreline stability.
- Biodiversity and ecosystem restoration – Reefs support invertebrates, plants, and algae that form the base of the aquatic food chain. They contribute to habitat reconstruction in areas affected by dredging, shipping, or pollution.

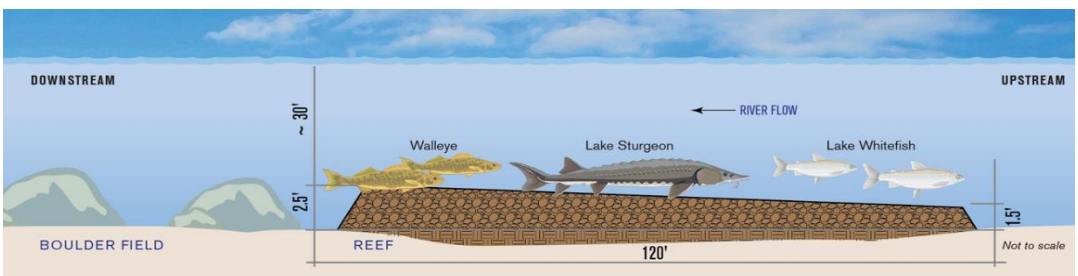


Figure 39. An Artificial Reef

[29] illustration from phys.org

3.4.3. Upland Restoration

Upland restoration encompasses the enhancement and rehabilitation of land areas located inland and upslope from immediate shoreline regions. Within the Great Lakes region, these upland areas are integral to the health and resilience of coastal systems. By effectively managing water, stabilizing soil, and supporting native ecosystems, upland restoration initiatives contribute significantly to coastal resilience. This resilience pertains to the capacity of shorelines and communities to withstand and recover from erosion, flooding, and other climate-related impacts.

Riparian Stabilization Measures

Riparian stabilization refers to the process of protecting and restoring vegetated areas along the banks of rivers, streams, and other waterways.[30] In the context of the Great Lakes, this process is important for coastal resilience as it improves watershed health and reduces the movement of sediment, pollutants, and excess water into nearshore environments. Eroding riverbanks contribute large amounts of sediment to lakes, which can smother fish habitat, degrade water quality and clog harbors and wetlands. Riparian stabilization involves practices that prevent erosion along streambanks such as stabilizing the soil using vegetation and natural materials, such as woody debris. Riparian stabilization techniques include live stake plantings such as willows, vegetated buffers with native plant species to anchor the soils, brush layering or fascines involving long cylindrical bundles of wood branches placed on slopes, re-grading banks to more stable angles, and installing coir logs or erosion blankets made from biodegradable materials that protect the banks as vegetation is established. Stabilizing the restoring riparian areas also reduces upland flooding from storms, as riparian zones slow and absorb stormwater, reducing peak flows during heavy rainfall, which lessens the impacts of surface water on downstream shorelines and infrastructure. Riparian restoration also improves fish and wildlife habitat, as these areas are essential corridors for fish, birds, amphibians, and pollinators.

Figure 40. Example of Riparian Stabilization

[30] Photo Credit: Genesee River Watch, geneseeriverwatch.org

Green Stormwater Infrastructure

Green stormwater infrastructure (GSI) involves practices and systems that capture, slow, filter, and infiltrate stormwater runoff in inland areas before it reaches waterways. In the Great Lakes region, upland GSI helps manage water, reduce erosion and flooding, and improve water quality to support coastal resiliency. Examples of GSI include raingardens, bioswales, permeable pavements, green roofs, vegetated retention basis, and constructed wetlands.[31] These systems are typically installed in urban, suburban, or agricultural areas where impervious surfaces like roads, roofs, and parking lots create large volumes of fast-moving runoff. Detroit and Milwaukee have implemented large-scale GSI networks in urban areas to reduce combined sewer overflows (CSOs), improving water quality in Lake Michigan and Lake Erie, such as the Detroit water and Sewerage Department's Green Infrastructure Program, the Joe Louis Greenway, the Milwaukee Metropolitan Sewerage District's (MMSD) Green Seams Program, and the Green Infrastructure Partnership Program. GSI supports coastal resilience by reducing stormwater volume and peak flow, improving water quality, and minimizing bluff and shoreline erosion.

Figure 41. A green roof in Milwaukee

Floodplain Reconnection & River Restoration

Floodplain reconnection and river restoration are nature-based approaches that aim to restore the natural functions of rivers and their adjacent landscapes. These strategies are especially important in the Great Lakes region, where tributaries, wetlands, and coastal areas are interconnected and influenced by upstream watershed conditions. Together, these practices enhance coastal resilience by reducing flood risk, improving water quality, supporting biodiversity, and restoring the natural flow of water through the landscape. Floodplain reconnection is the process of restoring the natural connection between a river and its floodplain, which has often been lost due to channelization (i.e., straightening of streams), dam construction, and urban development. Reconnecting the floodplain means allowing water to overflow onto low-lying land during high-flow events, which mimics how rivers historically behaved before being altered. Slowing surface water and spreading it on an improved floodplain reduces the downstream risk of flooding, promotes groundwater recharge and natural infiltration, helps restore wetland habitat that supports more diverse species, and reduces sediment and nutrient runoff to Lake Erie.

Reconnecting floodplains is just one aspect of overall river restoration, which involves returning altered or degraded rivers to a more natural, dynamic state. River restoration is achieved through various methods including removing levees or berms, restoring meanders or natural channel shapes, replanting

[31] Photo Credit: Milwaukee Metropolitan Sewerage District, MMSD.com

riparian vegetation, adding instream structures such as riffles and pools, and reestablishing natural flow regimes.[32]

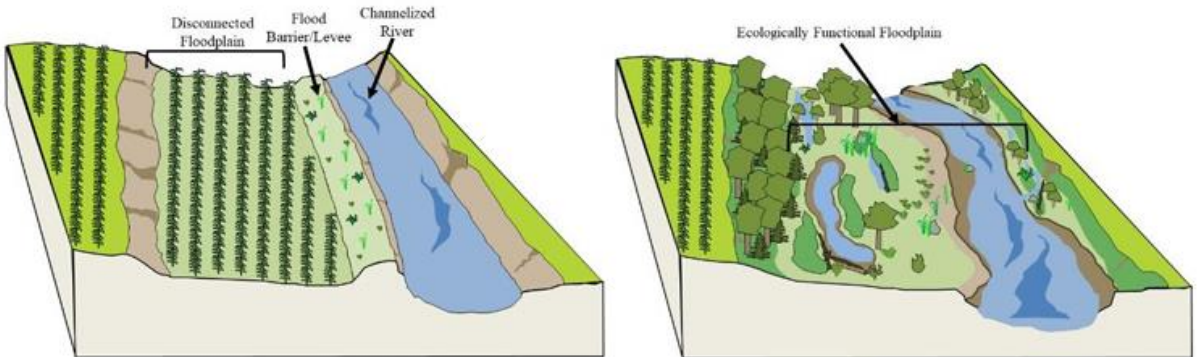


Figure 42. Comparison of Disconnected Floodplain versus an Ecologically Functional Floodplain

Beneficial Use of Dredge Material

The beneficial use of dredged material refers to the strategic reuse of sediment removed during dredging (typically from navigation channels, harbors, and ports) for environmentally, economically, and socially valuable purposes. Instead of treating dredged material as waste, it's increasingly being used to enhance coastal resilience, restore habitats, and adapt to the impacts of climate change and erosion. The Great Lakes region generates millions of cubic yards of dredged sediment annually, particularly in major shipping and harbor areas such as in Conneaut. Beneficial reuse of material can reduce reliance on costly disposal, offset sediment deficits in eroding shorelines, support ecosystem restoration and promote sustainable dredging and shoreline management practices.

Dredged material has been used for the construction of islands, marshes and habitat development projects across the US. In 2015, it was estimated that 1,000,000 birds' nest on dredged material islands each year (USACE 2015). USACE has created a guidance document titled *Environmental Evaluation and Management of Dredged Material for Beneficial Use: A Regional Beneficial Use Testing Manual for the Great Lakes* (also known as the Great Lakes Beneficial Use Testing Manual). This document provides technical guidelines for assessing the suitability of dredged sediment for beneficial use in aquatic and terrestrial environments in the Great Lakes region (USACE 2022). In this most recent manual, USACE categorized dredged sediment management into "aquatic placement" which includes habitat creation in wet environments, shore protection, and capping/remediation. Or "upland placement" which includes habitat development for land restoration or agricultural purposes, upland fill sites for human development, and manufactured products. Aquatic placement, which is most relevant in the case of Conneaut's harbor, has benefits that range from storm protection, and habitat enhancement. Successful examples of such aquatic placement sites can be seen in previous projects within the Great Lakes Region, namely the Cat Island Project in Green Bay for shoreline protection or the habitat creation in Duluth-Superior Habor.

Key resilience-focused applications of dredged material in the great lakes and their outcomes are outlined in Table 5.

[32] Illustration: Olivia Dorthy, Healthy Floodplains Reduce Nutrient Pollution, https://www.wateronline.com/doc/healthy-floodplains-reduce-nutrient-pollution-0001

Table 5. Resilience-Focused Applications of Beneficial Dredge Material

Function	Resilience Outcome
Wetland restoration	Buffers storms, stores floodwaters, filters runoff
Beach nourishment	Reduces erosion, protects property and public lands
Habitat enhancement	Increases biodiversity and ecosystem stability
Bluff and shoreline stabilization	Reduces sediment loss and risk of landslides
Island creation	Deflects wave energy, protects fragile shoreline ecosystems

3.5. Resilience Actions

Evaluating various coastal resilience strategies during a coastal resilience planning effort is critical because it helps ensure that the selected strategies are effective, sustainable, and tailored to the specific needs and challenges of the coastal environment and its communities.[33] This process allows for informed decision-making that considers the unique environmental, social, and economic factors at play, ultimately leading to a more resilient coastal community that can better withstand future challenges and recover more effectively after disasters. CPA and the planning team evaluated the strategies outlined in Section 3.4 to determine which strategies and specific methodologies would be best suited to provide climate resilience solutions for Conneaut, Ohio. Incorporation of green infrastructure to reduce climate impacts was one of the main objectives during the analysis. The specific actions that the planning team will use varies by project. Table 6 outlines the various actions/practices that will be designed, permitted, and implemented in Conneaut to support coastal resilience.

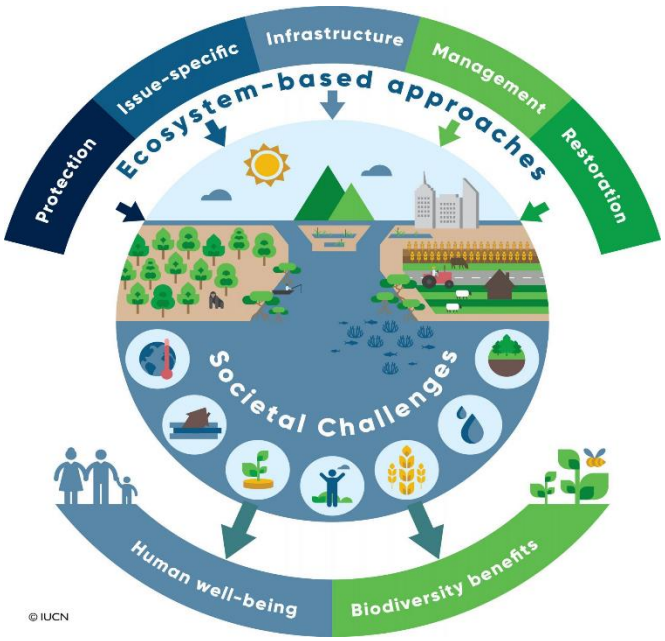


Figure 43. Nature Based Solutions as Resilience

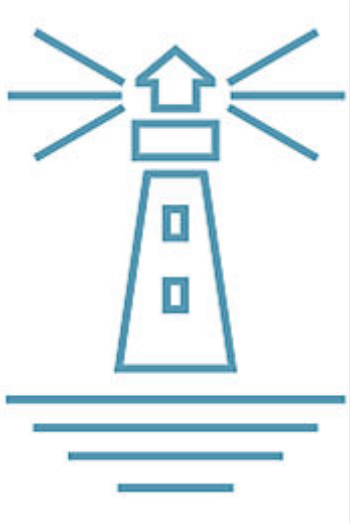
[33] IUCN Commission on Ecosystem Management, iucn.org/our-work/nature-based-solutions

Table 6. Proposed Resilience Actions for Conneaut, OH and their Benefits

Resilience Strategy	Resilience Action/Practice	Benefit
Coastal Wetland Restoration	Reestablishing Hydrology	Improves floodwater storage, groundwater recharge, and wetland function.
	Invasive Species Removal	Enhances ecosystem resilience, habitat quality, and reduces fire and flood risk.
	Native Vegetation Planting	Stabilizes soil, supports wildlife, and improves stormwater filtration.
	Sediment Augmentation or Grading	Increases wetland resilience to erosion and rising water levels.
	Wetland Creation	Improves water quality and reconnects habitats.
Beach Replenishment	Strategic Sediment Placement	Mimics natural coastal dynamics, enhances beach width, reduces impacts of storm surge.
	Dune Restoration or Construction	Enhances wildlife habitat, provides natural barriers to reduce the impacts of storm surges and flooding, helps trap wind-blown sand to maintain beach elevation.
	Native Vegetation Plantings	Enhances wildlife habitat, protects threatened or endangered plants, reduces erosion, mitigates flooding impact
	Sand Fencing, Coir Logs,	Reduces erosion, mitigates impacts of wave action
	Congruent Sediment Sourcing	
Gray/Green Coastal Shore Protection Structures	Gray Coastal Structures (bulkheads, revetments, breakwaters)	Holds soil in place and reduces erosion, protects from wave action
	Gray/green coastal armament (vegetated breakwaters, sills, edging)	Holds soil in place and reduces erosion, protects from wave action, offers some wildlife habitat
Bluff Protection Measures	Building relocation	Increases building lifespans, restores property values, moves building impacts away from bluffs
	Bluff toe protection (riprap, stone revetments, offshore breakwaters)	Protects against erosion and wave action
	Grading and terracing	Reduces bluff slope steepness improving stability
	Surface water management (drainage controls, rain gardens, vegetated swales)	Reduces erosion impact from upstream runoff
	Invasive species removal and native vegetation planting	Increases bluff soil stability, removes excess groundwater to retain soil strength

Resilience Strategy	Resilience Action/Practice	Benefit
Fish Habitat Improvements	Native plantings	Provides fish habitat and enhanced spawning success, aids in shoreline stability, provides habitat in aquatic-upland transition areas
Shoreline and Wetland Enhancement	Living Shorelines	Provides a buffer to upland areas, provides protection from wave action, creates and restores natural plant communities and provides wildlife habitat, improves water quality through filtration, adapts to changing lake levels, cost effective
	Floating wetlands	Reduces algal blooms, supports fish, birds, and pollinators, protects from wave and boat wake impacts, adaptable to various shoreline conditions, increases resilience to flooding and water quality degradation
	Constructed or restored reefs	Wave energy reduction, sediment stabilization, biodiversity and ecosystem restoration,
Riparian Stabilization	Native Plantings and natural material stabilization	Stabilizes soil, provides aquatic and riparian habitat, reduces sediment movement, reduces peak flow impacts
	Stream daylighting	Restores natural stream paths and reduces impacts from peak flows, provides increased habitat
	Removal of impoundments	Allows for desired surface/stream flows and positively impacts surface water quality
Green Stormwater Infrastructure	Rain gardens and bioswales	Slows surface runoff, improves downstream water quality, provides habitat
	Permeable pavements	Reduces surface runoff, improves downstream water quality
	Green roofs	Reduce urban heat island effect, provide habitat
Beneficial Use of Dredge Material	Wetland restoration	Buffers storms, stores floodwaters, filters runoff
	Beach nourishment	Reduces erosion, protects property and public lands
	Bluff and shoreline stabilization	Reduces sediment loss and risk of landslides
	Island creation	Deflects wave energy, protects fragile shoreline ecosystems

One tool that creates opportunities for the funding of resiliency strategies involves public private partnerships for managing and restoring privately held lands. In Euclid, Ohio, a group of nearly 100 property owners negotiated the transfer of permanent easements on their land with Cuyahoga County. The land where the easements were given includes a shoreline that has been subject to dramatic erosion in recent years. The creation of this type of conservation district unlocked public funding which was used to stabilize the shoreline and create a public trail along ¾ of a mile of Lake Erie coastline.



Chapter 4. Project Solicitation

4. Project Solicitation

One of the main goals of the Plan is to identify and describe a suite of green infrastructure projects that address the areas of habitat and economic concern acknowledged during the planning process. Over the past year of planning efforts, throughout the engagement events, calls with stakeholders, community members, and after review from technical experts, our Team has created a running list of the "universe of projects." The "universe of projects" is defined as a near comprehensive set of potential projects that can be implemented to enhance fish and wildlife habitat and community resilience along the 6-mile Conneaut shoreline of Lake Erie. The intent of this list is not to have a final and comprehensive accounting of all the possible restoration projects within Conneaut region. Instead, the list will serve as a living document, to be added to overtime, as prioritized projects are moved through the next phases of development (i.e., engineering/design, permitting, implementation, and monitoring). To move projects forward through development and implementation, a Multi-Criteria Decision Analysis (MCDA) evaluation system was used to prioritize which projects will seek continued funding. The methodology used for identifying and prioritizing projects is described below.

4.1. Project Proposal Submission

Seeking project ideas and input into potential resilience actions is a core element of this Plan. CPA endeavored to gather public and stakeholder feedback on nature-based and green infrastructure projects through a structured, inclusive process. This process included collaborative planning sessions during in-person and virtual meetings, providing opportunities to submit ideas directly to the planning staff (via emails, online forms, surveys, etc.), and through community feedback loops. Inherently, through the multiple drafts of this Plan shared with the stakeholders and the public, the CPA has created a feedback loop, where ideas are presented to the community for feedback and refinement. Online project submission forms on the CPA website will stay active after the planning process to allow for continued input into this living document. All submitted projects will then be entered into the "universe of projects" and evaluated for feasibility.

4.2. Project Selection Criteria & Process

All projects presented to the CPA through the outreach events, virtual meetings, private calls, emails, and via the online form (the "universe of projects") have been evaluated by the technical team for general, high-level feasibility considerations (i.e., does the project include elements of green design, does it address the environmental issues identified, can the project be built, etc.). After initial evaluation, the technical team utilized a MCDA matrix to appraise and compare the different project alternatives to help the CPA prioritize which projects should be designed and implemented first. A MCDA matrix is a useful tool that assists with formulating complex decisions when several conflicting objectives or factors need to be considered simultaneously. The matrix works by providing a systematic approach to decision-making and reduces bias by incorporating multiple perspectives. As applied during this planning process, the matrix has helped the CPA assess which project options are most effective in achieving desired resilience outcomes, such as improving shoreline protection, water quality, habitat connectivity, improved public safety, reduced erosion, and improved stormwater management. The MCDA framework considers a diversity of criteria that include (but not limited to) cost, environmental and climate-related thresholds, social perceptions, stakeholder and partner capacities, and permitting requirements. Each criterion is assigned a weight that reflects its importance relative to the other criteria. The weightings can be based on expert judgment, stakeholder input, or other methods of prioritization. Using the MCDA methodology, CPA can provide transparency to our constituents as to why some projects have been prioritized over others.

4.2.1. MCDA Process

Development of the MCDA was accomplished through an iterative process between the CPA and our technical experts. The MCDA process outlined here represents a systematic approach to evaluating and prioritizing potential projects based on multiple criteria. This methodology ensures that decisions are made transparently and with a balanced consideration of various factors. By following these steps, the CPA has been able to prioritize the projects included in this Plan based on the results of the MCDA matrix.

Step 1. Define the Potential Projects

The first step involved defining the potential projects. This step is crucial as it sets the stage for the entire evaluation process. The "universe of projects" list serves as the foundation, from which initial ideas are filtered through high-level feasibility considerations by technical experts. This initial screening ensures that only projects aligning with the overarching goals of the CPA move forward for further evaluation. For this planning effort, CPA received eleven (11) potential project ideas that were deemed initially feasible.

Step 2. Define the Evaluation Criteria

Next, the evaluation criteria were determined. These criteria are essential as they provide the basis upon which each project will be assessed. The evaluation criteria are those key factors CPA and the planning team, with input from stakeholders and the public, determined are important. Each criterion is carefully defined to ensure that it effectively captures the key aspects of project performance and aligns with the community's resilience objectives. Table 7 describes the evaluation criteria chosen for this planning effort.

Table 7. MCDA Proposed Criteria Definitions

Proposed Criteria	Criteria Definition
Technical Feasibility	The practical ability to design, engineer, and implement a proposed solution using existing technology, methods, and materials within the constraints of the site conditions. Does the project promote nature-based designs? What is the efficacy of utilizing green infrastructure vs. grey infrastructure. Are there major technical issues and challenges to project implementation? Are projects relying on manmade materials or local natural materials?
Permittable	"Permittable" refers to whether the proposed project can obtain the necessary legal and regulatory approvals from local, state, and federal agencies to proceed with construction and implementation. Are there anticipated permitting challenges? Does this project require special permits or unusual permits? Are agencies supportive from a permitting perspective? Have similar projects been permitted by the regulatory agencies (i.e., is there precedence?).
Time to Implement	The time it will take for a project to move from a conceptual plan, through engineering and design, to implementation and finally monitoring and adaptive management; Essentially, the project schedule. Will this project take a long time to get built, resulting in a delay of anticipated benefits?
Ecological Benefits	The positive impacts a project has on the health, function, and biodiversity of natural ecosystems. These benefits go beyond physical protection from hazards - they support and enhance natural processes that sustain both the environment and the people who depend on it. Examples include water quality improvements, habitat improvements, expanded carrying capacity for plants/animals, and increased foraging habitat. Are projects promoting habitat improvements and/or enhancing natural processes?
Cost	The total project costs, including engineering, design, permitting, implementation, and monitoring. This criterion should also consider long-term maintenance costs.

Proposed Criteria	Criteria Definition
	Are project costs prohibitive? Does the project require long-term maintenance? Is funding available?
Long-Term Sustainability	The project's ability to remain effective, functional, and beneficial over time, especially as environmental conditions, climate patterns, and community needs continue to change. Examples include resilience to future environmental, weather conditions, and use conditions. Does the project provide a long-term economic benefit to the region? What is the life expectancy and longevity of the project?
Community & Stakeholder Support	The engagement, endorsement, and active involvement of local residents, landowners, businesses, governments, nonprofits, and other affected or interested parties throughout the planning, design, and implementation of the project. Have the public and stakeholders expressed particular interest in the project? Is there an expressed need for the project?
Human & Economic Risk Reduction	The strategies and outcomes aimed at minimizing harm to people, property, infrastructure, and local economies from coastal hazards such as erosion, flooding, storm surge, and extreme weather events. What's the long-term project benefits to humans and the economy? What is the economic risk to critical infrastructure (i.e. roadways or bridges), and human health if the project is not built?

Step 3. Weight the Criteria

Once the criteria were established, they are weighted according to their importance. This step involves assigning a weight to each criterion, reflecting its relative significance in the decision-making process. The weightings were derived from expert judgment, their significant to CPA, and stakeholder and community input (Table 8). The total weight of all the criterion needs to equal 1.0 for the matrix to be effective.

Table 8. MCDA Criteria Proposed Weights

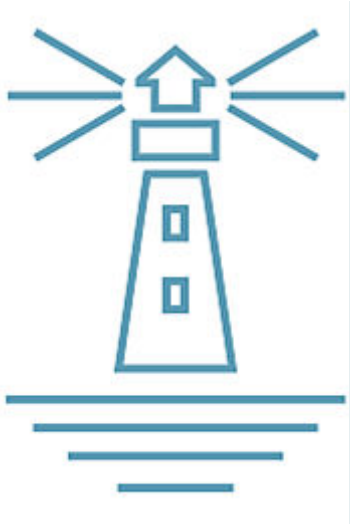
Proposed Criteria	Proposed Weight
Technical Feasibility	0.18
Permittable	0.16
Time to Implement	0.08
Ecological Benefits	0.13
Cost	0.1
Long-Term Sustainability	0.13
Community & Stakeholder Support	0.1
Human & Economic Risk Reduction	0.12
Total Weight of Criterion	**1.0**

Step 4. Score the Projects

The penultimate step in the MCDA process involves scoring the projects. Each project is rated on a scale of 1 to 5 for each criterion, with 1 being poor and 5 being excellent. CPA worked with the planning team to create a draft rating for each project (Appendix B). The draft scoring has been presented in the drafts of this plan to the stakeholders and the public for input and editing before these scores are finalized and published in the final living document.

Step 5. Calculate the Weighted Scores

~~Each score was multiplied by the criterion w~~eight to get the weighted score for each project. The overall scores are presented for each project in Section 5. This scoring system allows for a nuanced assessment of project performance across multiple dimensions. The draft scores have been presented to stakeholders and the public for input and refinement, ensuring that the final scores reflect a broad consensus. It is important to note that any projects that are added to the universe of projects over time, will be added to this plan on a rolling basis and will be evaluated using the same MCDA matrix, criterion and weighted score.



Chapter 5. Resilience Projects

5. Resilience Projects

The Projects described in Section 5.0 are those that have been selected out of the universe of projects based on the high-level technical feasibility analysis and have been evaluated via the MCDA matrix. Feasibility of these projects has been determined based on a detailed desktop analysis, observational data, input from resource agencies and stakeholders, and technical project knowledge from our experts. During this process, we have identified data gaps that have been called out for future investigation du ring the engineering and design process. For each of the projects in this Plan, the relevant information neededfor the CPA and other interested parties to be able to seek future funding for engineering, design, andimplementation was included, such as the proposed resilience actions, the approximate costs, the typesof permits required, etc.

5.1 Coastal Marsh Rehabilitation

Figure 44. Proposed Coastal Marsh Restoration

Weighted MCDA Score:

GPS Coordinates: 41°58'2.17"N, 80°33'29.34"W

Background & Location: The emerging wetland and beach complex that has formed inside of Conneaut harbor's western breakwater offers significant recreation and habitat benefits. This sandbar turned marsh is a recent arrival to this stretch of Lake Erie's shore. Both residents and historical aerials confirm that it first formed in the mid 1990's (though it was certainly growing for years beneath the water). Created by the natural migration of sand down the coast, its emergence has financial implications for Conneaut's Port Authority. As the agency charged with maintaining the commercial marinas, they are responsible for dredging any excess material out of the boat channels. The beach portion of the coastal marsh is very popular with visitors to neighboring Conneaut Township Park. Unlike most of the beaches in the area, this stretch is within the port's breakwater and the waters are calm enough for paddleboarding and other popular water activities.

Figure 45. Gull and tern species at Conneaut Township Park

Arieal imagery shows that the vegetation that has colonized the sandbar over the past 30 years has created a coastal marsh which is a locally rare habitat and critical for many native shorebirds (Google Earth 2025). Birders know the Conneaut Harbor as a birding hotspot and "flock" to the area in the spring to see migrating birds and at other times of the year to view shorebirds. A similar habitat 20 miles away at Presque Isle in Pennsylvania has recently hosted the first nesting pair of Common Terns in many years.[34] This endangered bird was once extirpated from the region but is slowly making a comeback.

Designated an Important Bird Area (IBA) by the National Audubon Society, Conneaut is the only bit of increasing mudflat habitat between Huron and Presque Isle in Pennsylvania (National Audubon Society 2025). The harbor has been changing over the years and marsh species are increasing. This is the principal shoreline staging area for birds in Northeast Ohio along Lake Erie. It is both a spring and fall site for shorebirds, as estuaries such as this are relied upon in the deeper central basin of Lake Erie. It is a raptor and vulture migratory corridor. Gulls concentrate at Conneaut in both spring migration and during winter. This spot is characteristically very transient in nature for birdlife. Records of nesting Least Bittern and Marsh Wren in the associated wetland exist. In addition, Merlin's have been observed during the summer months along the gorge upstream and have been recorded hunting (eBird 2021).

The coastal marsh, unfortunately, is anything but stable. Sand continues to move into it from the east and is lost from the system as it moves into the boat channels or the deeper parts of the harbor. Lake levels have also been notoriously difficult to predict. The 10-year period between 2010 and 2020 saw Lake Erie's mean water level climb nearly 3 feet (GLISA 2021). For plants that rely on stable hydrology this marsh is an unforgiving environment. Non-native invasive plants have taken advantage of the situation and now common reed (*Phragmites australis*) dominates the landscape.

Project Description & Proposed Activities: This project will restore approximately 13 acres of degraded littoral wetlands along the western shoreline of Lake Erie. The restoration effort will involve hydrologic reconnection, invasive species removal, native vegetation replanting, sediment removal or reshaping, and the installation of natural shoreline features to reduce erosion. The project will be implemented in partnership with local conservation organizations, academic researchers, and government agencies. It will utilize a nature-based approach to enhance ecosystem services while supporting the resilience of nearby coastal communities against climate-driven threats such as flooding, storm surges, and shoreline erosion. Field data will be collected to produce floristic quality assessments and establish transects for future monitoring. Additionally, a bathymetric survey and hydraulic and sediment transport modeling will guide restoration design, ensuring alignment with projected lake level changes, increased precipitation, and storm intensity due to climate change. A metocean analysis will include a technical evaluation of wave action and water levels at the existing site. Active engagement with local communities will be embedded throughout the planning and implementation phases to promote stewardship and equitable benefit-sharing.

[34] Photo Credit: ODNR, greatlakesecho.org

The project will include a long-term stewardship plan to guide future management. A coastal marsh rehabilitation plan will identify both short term and long-term measures that protect existing habitats for native plants and animals. Strategies will be included that preserve access to the public for recreation and plan for the fluctuation of lake levels. Work will include a thorough analysis of existing conditions, preparation of an open space management plan, the creation of restoration plans for the first phase of work, and construction of phase one improvements.

Vulnerability Assessment: The coastal marsh at the sandbar is highly susceptible to fluctuating lake levels. The composition of the plant community here is directly related to the change in inundation over the years. Some volatile aspects of the site's ecology, however, such as the increasing mudflats have benefits to shorebirds.

Resilience Strategies: Strategies for rehabilitating the coastal marsh will include nature-based strategies for shoreline stabilization, guidance on nearby dredging activities, a soil management plan, control of invasive plants, and replanting native plants.

Costs: Project costs will include the following:

1. Analysis of Existing Conditions $30,000 to $50,000
2. Open Space Management Plan $45,000
3. Phase 1 Restoration Design $80,000 to $100,000
4. Construction of Phase 1 Restoration $350,000 to $500,000

Permitting: Federal, state and local permitting will be evaluated during the engineering and design phase of the project. However, based on funding sources, potential impacts, and likely restoration activities, the permits this project will likely require are:

- NEPA compliance, likely due to receiving federal funds.
- SHPO and THPO coordination for compliance with the NHPA
- Nationwide Permit (USACE)
- 401 Water Quality Certification (ODNR)
- Coastal Management Consistency Certification (ONDR)
- Wetland Permitting (OEPA)
- T/E Species Assessment/Review (ODNR)
- Building Permit (Conneaut)

Timeline: A preliminary schedule for these activities is:

1. Analysis of Existing Conditions 3 to 6 months
2. Restoration Design Alternatives 3 to 4 months
3. 30% - 60% Restoration Design 2 to 4 months
4. Environmental Permitting 6 to 12 months
5. 60% - 90% Restoration Design 2 to 4 months
6. Final Design & Permitting 4 months
7. Open Space Management Plan 2 months
8. Construction 8 months

Anticipated Resiliency Outcome: The desired outcomes of this project include increased habitat diversity for the coastal marsh and an improved ability for the habitat to bounce back after major storms or lake level fluctuations.

Next Steps: The next steps for this project will include: a bathymetric survey and topographical survey of the site; metocean analysis of wave action and lake levels; floristic quality inventory/assessment; community/stakeholder engagement; preparation of open space management plan; restoration design alternatives; 30% - 60% designs; restoration plans; permitting, 60% - 90% designs; final designs; construction; monitoring.

5.2 Marina Drive Reconstruction and Constructed Wetland

Figure 46. Proposed Marina Drive Reconstruction & Constructed Wetland

Weighted MCDA Score:

GPS Coordinates: 41°58'11.10"N, 80°33'13.87"W

Background & Location: The Marina Drive extension within Conneaut Harbor is a breakwater structure that protects a portion of the CPA's marina along with the private Conneaut Boat Club. Boaters take advantage of the drive as a convenient place to park their cars. It also serves as a popular location for shoreline fishing. While the drive is protected by the harbor's main breakwaters, the CPA reports that many severe storms still manage to cause damage to the road's surface which is a combination of asphalt and compacted gravel. Some storms are so severe that they have moved entire fields of rock and debris onto the road surface – some pieces as large as a car tire. The waves and debris from these storms have damaged critical infrastructure and have led to sediment eroding back into Lake Erie. Also concerning is that the configuration of the pavement does not adequately separate anglers from the mix of parked cars and driving lanes leading to dangerous conflicts between pedestrians and vehicles.

Project Description & Proposed Activities: The Marina Drive Reconstruction and Constructed Wetland project will reconstruct 1,150 feet of public roadway and its adjacent shoreline to address infrastructure protection, water quality, and safety/access concerns. A new barrier island will be constructed in the harbor within areas managed by the CPA under their submerged lands lease. The island will be

constructed of material dredged from the adjacent marina and boat channel areas. It will create 6 acres of habitat for native coastal marsh plants. It will also defend the Marina Drive extension by absorbing wave action coming from the northwest.

Marina Drive's pavement will be reconstructed using permeable interlocking concrete pavers. This material is more durable than the existing asphalt and crushed stone paving. It is also more flexible than other pavement options such as poured concrete. Rainwater runoff from the new paved surfaces will be detained and filtered within the permeable pavement as well as by rain gardens placed between the pavement and shoreline. These measures will improve the water quality within the harbor. The project will also have an educational component by highlighting Lake Erie's water cycle and instructing visitors on measures that they can take to battle pollutants through the use of green infrastructure like rain gardens. Newly striped parking stalls and pedestrian paths will separate pedestrians from vehicles making the breakwater safer for anglers.

A bathymetric survey and hydraulic and sediment transport modeling will guide restoration design of the barrier island, ensuring alignment with projected lake level changes, increased precipitation, and storm intensity due to climate change. A metocean analysis will include a technical evaluation of wave action and water levels at the existing site. Active engagement with local communities will be embedded throughout the planning and implementation phases to promote stewardship and equitable benefit-sharing. The project will include a long-term stewardship plan to guide future management. An open space management plan will identify both short term and long-term measures to establish habitats for native plants and animals. Strategies will be included that preserve access to the public for recreation and plan for the fluctuation of lake levels.

The scope of work for this project will include an analysis of existing conditions, community/stakeholder engagement, preparation of preliminary engineering plans, permitting, final engineering plans, construction, and monitoring during the establishment phase. **Vulnerability Assessment:** While located within the protected harbor, the location of the Marina Drive extension on top of an interior breakwall places it in a precarious position and makes it highly susceptible to damage from future storm events.

Resilience Strategies: Resiliency measures will include newly constructed wetlands that will act as barrier islands, beneficial use of dredge material, green stormwater infrastructure such as permeable paving and bioretention, educational signage, and safety/access improvements for visitors.

Costs: Project costs will include the following:

1. Analysis of Existing Conditions $75,000 to $100,000
2. Community/Stakeholder Engagement $15,000 to $25,000
3. Preliminary Engineering Plans $250,000 to $300,000
4. Permitting $150,000 to $200,000
5. Final Engineering Plans $500,000 to $700,000
6. Construction $3.5 million to $5 million
7. Monitoring $50,000 to $75,000

Permitting: Federal, state and local permitting will be evaluated during the engineering and design phase of the project. However, based on funding sources, potential impacts, and likely restoration activities, the permits this project will likely require are:

- NEPA compliance, likely due to receiving federal funds.

- SHPO and THPO coordination for compliance with the NHPA
- Individual 404 Permit (USACE)
- 401 Water Quality Certification (ODNR)
- Shore Structure Permit (ODNR)
- Coastal Management Consistency Certification (ONDR)
- Wetland Permitting (OEPA)
- T/E Species Assessment/Review (ODNR)
- Building Permit (Conneaut)
- Stormwater Pollution Prevention Plan (Conneaut)

Timeline: A preliminary schedule for these activities is:

1.	Analysis of Existing Conditions	6 months
2.	Community/Stakeholder Engagement	Throughout
3.	Preliminary Engineering Plans	8 months
4.	Permitting	24 months
5.	Final Engineering Plans	6 months
6.	Construction	24 months
7.	Monitoring	72 months

Anticipated Resiliency Outcome: The desired outcomes of this project include added habitat for native plants, fish, and other wildlife, improved water quality (reduction in TSS), protection of the roadway and marina infrastructure, protection of visitors from hazards, and increased awareness of coastal resiliency measures through educational signage.

Next Steps: The next steps for this project will include: pre-application meetings with regulators; bathymetric survey and topographical survey of the site; metocean analysis of wave action and lake levels; stakeholder engagement; design/engineering of restoration plans; individual 404 permit with USACE and alternatives analysis; public review/comment; other permitting; construction of restoration measures; and monitoring of vegetation establishment.

5.3 Naylor Drive Green Infrastructure

Figure 47. Proposed Green Infrastructure Project at Naylor Drive

Weighted MCDA Score:

GPS Coordinates: 41°57'55.92"N, 80°33'26.68"W

Background & Location: Naylor Drive is an important access road within the Port of Conneaut. Along with the Marina Drive extension it is one of the primary lakeside roads used to access public lands in the City of Conneaut. It stretches a little over a quarter of a mile and connects the popular recreational assets of the marina to the east with Conneaut Township Park Beach to the west. The CPA is planning to expand its marina by constructing boat slips in the harbor immediately adjacent to Naylor Drive. Plans for the expansion were recently completed and are currently in the permitting phase.

The CPA expressed several concerns about this area during stakeholder meetings. One concern is that the existing road may be inadequate to handle its future uses. The narrow pavement only accommodates one lane of travel and there is not a dedicated sidewalk for pedestrians to use. There are also no measures to detain and treat rainwater runoff from the road. It currently sheet drains directly into the harbor.

Project Description & Proposed Activities: The Naylor Drive Green Infrastructure project seeks to accommodate the future expansion of Naylor Drive by constructing 9,000 square feet of rain gardens along the shore between the road and the harbor. The rain gardens will intercept and treat rainwater runoff from the road before it reaches Lake Erie removing nutrients and suspended solids in the process. The basins will detain and treat the runoff from the 100-year rain event. The project will also have an educational component by highlighting Lake Erie's water cycle and instructing visitors on measures that they can take to battle pollutants through the use of green infrastructure like rain gardens.

The scope of work for this project will include an analysis of existing conditions, topographic/utility survey, community/stakeholder engagement, preparation of preliminary engineering plans, permitting, final engineering plans, and construction.

Vulnerability Assessment: Lakeside infrastructure, like Naylor Drive, is particularly vulnerable to impacts from storm surges. The water quality of the nearby wetlands is also threatened by the pollutants contained in the runoff from the roadway surfaces.

Resilience Strategies: Resiliency measures will include green stormwater infrastructure such as permeable paving and bioretention, native planting, as well as educational signage.

Costs: Project costs will include the following:

1.	Analysis of Existing Conditions	$45,000 to $60,000
2.	Community/Stakeholder Engagement	$15,000 to $25,000
3.	Preliminary Engineering Plans	$75,000 to $100,000
4.	Permitting	$25,000 to $50,000
5.	Final Engineering Plans	$250,000 to $300,000
6.	Construction	$2 million to $3 million

Permitting: Federal, state and local permitting will be evaluated during the engineering and design phase of the project. However, based on funding sources, potential impacts, and likely restoration activities, the permits this project will likely require are:

- NEPA compliance, likely due to receiving federal funds.
- SHPO and THPO coordination for compliance with the NHPA
- T/E Species Assessment/Review (ODNR)
- Building Permit (Conneaut)
- Stormwater Pollution Prevention Plan (Conneaut)
- Stormwater Permitting (Conneaut)

Timeline: A preliminary schedule for these activities is:

1.	Analysis of Existing Conditions	6 months
2.	Community/Stakeholder Engagement	Throughout
3.	Preliminary Engineering Plans	8 months
4.	Permitting	12 months
5.	Final Engineering Plans	6 months
6.	Construction	24 months

Anticipated Resiliency Outcome: The desired outcomes of this project include improved water quality through removal of suspended solids and other pollutants, and increased awareness of coastal resiliency measures through educational signage.

Next Steps: The next steps for this project will include: pre-application meetings with regulators; topographical/utility survey of the site; stormwater modeling; stakeholder engagement; design/engineering of construction documents; permitting; and construction of green infrastructure.

5.4. Living Shoreline at Canadian National

Figure 48. Proposed Living Shoreline at Canadian National

Weighted MCDA Score:

GPS Coordinates: 41°58'15.54"N, 80°32'44.52"W

Background & Location: The Canadian National Railroad owns a quarter mile stretch of shoreline within Conneaut Harbor. This area is unique within the harbor in that it is protected from Lake Erie wave action by the harbor's outer breakwaters and from boat traffic by the inner harbor's east pier. Even so, it has been deprived of sediment from littoral drift so its banks are steep and highly eroded. While most of the upland immediately adjacent to this stretch of shoreline is used for heavy industry, the far east end connects directly to over 600 acres of woodland owned by the Railroad and Ashtabula County. The Turkey Creek Metropark owned by Ashtabula County contains wooded wetlands, rare species of plants and wildlife and 3 miles of Turkey Creek, an outstanding trout fishing stream (Ashtabula County Metroparks 2017).

This 500-foot stretch offers opportunities to connect habitats between a restored Lake Erie shoreline within the protection of the harbor and the natural resources of Turkey Creek Metropark having experienced particularly rapid erosion during the last 30 years. The Ohio DNR reports that a 200-foot stretch of shoreline, located east of the breakwater has shown recession rates of 1 foot to 5.3 feet per year (ODNR 202a). It may be affected by local currents produced by the breakwater or by rising lake levels. Its loss is concerning since it is a potential link between the calm waters of the harbor and the large natural upland area to the southeast. The area immediately above the bank contains an important access road and rail line for Canadian National's industrial operations. Much of this area sheet drains directly into the harbor. With less than 20 feet of vegetated banks between the road and the water there is not much space to filter and treat the runoff before it reaches Lake Erie.

Project Description & Proposed Activities: The Living Shoreline at Canadian National RR project will restore 1,500 feet of Lake Erie shoreline within Conneaut Harbor. The project will take advantage of the site's protected conditions and utilize nature-based restoration techniques. Dredge material from the recreational boat channels will be used beneficially to extend the shoreline lakeward by 30 feet. The new banks will be planted with native vegetation to improve the connection between the water and the large woodland managed by Ashtabula's Metroparks. The wider and shallower shoreline will protect important infrastructure and improve Lake Erie water quality by increasing the vegetative filter strip between impervious areas and the harbor.

The scope of work for this project will include an analysis of existing conditions, community/stakeholder engagement, preparation of preliminary engineering plans, permitting, final engineering plans, construction, and monitoring during the establishment phase. A bathymetric survey and hydraulic and sediment transport modeling will guide restoration design, ensuring alignment with projected lake level changes, increased precipitation, and storm intensity due to climate change. A metocean analysis will include a technical evaluation of wave action and water levels at the existing site. Active engagement with local communities will be embedded throughout the planning and implementation phases to promote stewardship and equitable benefit-sharing. The project will include a long-term stewardship plan to guide future management. An open space management plan will identify both short term and long-term measures to establish habitats for native plants and animals.

Vulnerability Assessment: This stretch of shoreline is partially protected by being within the outer breakwaters, but sections of it are experiencing rapid erosion due to wave action.

Resilience Strategies: Resiliency measures will include nature-based shoreline stabilization techniques, beneficial use of dredge materials, improvements to animal/fish habitat, planting of native vegetation, and vegetated filter strips to treat runoff.

Costs: Project costs will include the following:

1.	Analysis of Existing Conditions	$65,000 to $75,000
2.	Community/Stakeholder Engagement	$15,000 to $25,000
3.	Preliminary Engineering Plans	$100,000 to $150,000
4.	Permitting	$75,000 to $100,000
5.	Final Engineering Plans	$175,000 to $200,000
1.	Construction	$2.5 million to $3 million
2.	Monitoring	$50,000 to $75,000

Permitting: Federal, state and local permitting will be evaluated during the engineering and design phase of the project. However, based on funding sources, potential impacts, and likely restoration activities, the permits this project will likely require are:

- NEPA compliance, likely due to receiving federal funds.
- SHPO and THPO coordination for compliance with the NHPA
- Nationwide Permit (USACE)
- 401 Water Quality Certification (ODNR)
- Shore Structure Permit (ODNR)
- Coastal Management Consistency Certification (ONDR)
- Wetland Permitting (OEPA)
- T/E Species Assessment/Review (ODNR)

Building Permit (Conneaut)

Timeline: A preliminary schedule for these activities is:

1. Analysis of Existing Conditions 6 months
2. Community/Stakeholder Engagement Throughout
3. Preliminary Engineering Plans 8 months
4. Permitting 24 months
5. Final Engineering Plans 6 months
6. Construction 24 months
7. Monitoring 72 months

Anticipated Resiliency Outcome: The desired outcomes of this project include 5 acres of added coastal marsh and upland habitat, improved water quality through filtering sediments and other pollutants from adjacent road surfaces, stabilization of shoreline, and protection of habitat corridor to adjacent Turkey Creek.

Next Steps: The next steps for this project will include: pre-application meetings with regulators; bathymetric survey and topographical survey of the site; metocean analysis of wave action and lake levels; stakeholder engagement; design/engineering of construction documents; preparation of nation-wide permit with ODNR; other permitting; construction of restoration measures; and monitoring of vegetation establishment.

5.5. Beach Replenishment East of Conneaut Harbor

Figure 49. Proposed Beach Replenishment

Weighted MCDA Score:

GPS Coordinates: 41°58'18.54"N, 80°32'27.03"W

Background & Location: Since their construction over 100 years ago, the breakwaters around Conneaut's harbor have been shaping Lake Erie's shoreline. By disrupting the natural flow of littoral sediment along the coast, the breakwaters have created a large beach on one side and a sand depleted shore on the other. The loss of beach to the east of Conneaut is of such concern that Pennsylvania's Office of Coastal Resources Management listed replenishing sand resources in the western part of the state as a top priority at a recent summit. (site source) The disruption of littoral sand flow has a direct impact on the quality of habitat for native plants and animals. It degrades the function of coastal wetlands and nearshore environments leading to reductions in spawning and nursery habitat for native fish (Mackey 2012).

The boat channels and harbor areas are frequently dredged by the US Army Corps of Engineers and the Conneaut Port Authority. Anywhere from 50,000 to 200,000 cubic yards of sediment are removed each year (USACE 2024). The federal channels and the outer port which are managed by the Corps have been found to have silt and clay deposits which are unsuitable for beach replenishment. The areas to the west of Conneaut Creek, however, are more likely to have coarser sand deposits which would be suitable for nearshore placement. This includes the municipal channel managed by the Corps and the recreational channels and marinas managed by the CPA.

Project Description & Proposed Activities: The beach replenishment project will restore the natural beach profile of the shoreline east of Conneaut Harbor by transporting dredge material to the Corp's designated nearshore disposal area. This area is 1,500 feet to the east of the Conneaut Harbor's east breakwater, between –11 and –8 feet below mean water.

The scope of work for this project will include an analysis of existing conditions, community/stakeholder engagement, preparation of preliminary engineering plans, permitting, final engineering plans, construction, and monitoring during the establishment phase. A bathymetric survey and hydraulic and sediment transport modeling will guide restoration design, ensuring alignment with projected lake level changes, increased precipitation, and storm intensity due to climate change.

Vulnerability Assessment: The coastline east of Conneaut's east breakwater is highly vulnerable to future threats from severe storms as a direct result of beach loss.

Resilience Strategies: Resiliency measures will include beach replenishment and native plantings.

Costs: Project costs will include the following:

1.	Analysis of Existing Conditions	$40,000 to $50,000
2.	Community/Stakeholder Engagement	$15,000 to $25,000
3.	Preliminary Engineering Plans	$80,000 to $100,000
4.	Permitting	$60,000 to $80,000
5.	Final Engineering Plans	$100,000 to $150,000
6.	Construction	$2 million to $3 million
7.	Monitoring	$50,000 to $75,000

Permitting: Federal, state and local permitting will be evaluated during the engineering and design phase of the project. However, based on funding sources, potential impacts, and likely restoration activities, the permits this project will likely require are:

- NEPA compliance, likely due to receiving federal funds.
- Nationwide Permit (USACE)
- 401 Water Quality Certification (ODNR)
- Shore Structure Permit (ODNR)
- Coastal Management Consistency Certification (ONDR)
- Wetland Permitting (OEPA)
- T/E Species Assessment/Review (ODNR)

Timeline: A preliminary schedule for these activities is:

1.	Analysis of Existing Conditions	6 months
2.	Community/Stakeholder Engagement	Throughout
3.	Preliminary Engineering Plans	6 months
4.	Permitting	8 months
5.	Final Engineering Plans	6 months
6.	Construction	18 months
7.	Monitoring	36 months

Anticipated Resiliency Outcome: The desired outcomes of this project include stabilized shoreline conditions east of Conneaut Harbor with a reduction in near-term erosion rates. Other benefits will include improved habitat for native animals/fish.

Next Steps: The next steps for this project will include: pre-application meetings with regulators; bathymetric survey and topographical survey of the site; stakeholder engagement; design/engineering of construction documents; preparation of nation-wide permit with ODNR; other permitting; construction of restoration measures; and monitoring of vegetation establishment.

5.6. Wetland Park and Boardwalk

Figure 50. Wetland Park and Boardwalk

Weighted MCDA Score:

GPS Coordinates: 41°57'53.56"N, 80°33'34.93"W

Background & Location: At the nexus of three critical resources lies a triangular shaped property that is jointly owned and managed by the City of Conneaut and the Conneaut Port Authority. This upland area has 600 feet of shoreline and consists of mown turfgrass and a scattering of trees, but it could be so much more. The parklet lies at the intersection of the Naylor Drive connection and the recreational marina to the east, the sandbar coastal marsh to the north, and the Conneaut Township Park beach to the west. It offers opportunities to create important pedestrian and ecological connections between each of these resources.

This is also the location where one of the primary storm sewer discharges in the area is released into Lake Erie. The runoff in this sewer is collected from over 240 acres of upland area, most of which contains urban development. It emerges from the hillside in a 4'x3' box culvert before running through 350 feet of incised drainage channel. The channel contains mown vegetation along its steep banks and does little to slow down or treat the runoff before it enters the lake.

The adjacent Naylor Drive and backwater lagoon are very popular bird watching spots. The coastal marsh that has developed on the sandbar is a locally rare habitat for this part of Lake Erie and attracts migratory birds in the spring as well as nesting shorebirds at other times of the year (Ohio Ornithological Society, n.d.).. The CPA's plan to develop the lagoon into a marina will displace some of the birdwatching activity.

Project Description & Proposed Activities: The wetland park and boardwalk project will build 2 acres of constructed wetland which will intercept and treat up to 1.5 million gallons of runoff from the existing

storm and sewer discharge. This artificial wetland will displace the existing mown lawn and drainage ditch and will be planted with native vegetation to provide additional habitat for native plants and animals. It will collect rainwater runoff and remove sediments and excess nutrients before allowing the runoff to overflow into Lake Erie. A boardwalk will be constructed to both improve access to the adjacent coastal marsh and confine visitors to specific areas. The boardwalk will terminate in a lookout that will provide birders with an advantageous viewing platform. The project will also have educational components. Signage will highlight the unique ecology of the intentionally constructed wetland, the recently formed marsh, and the historic shoreline conditions. Important habitat elements for birds will be identified and visitors will be instructed on ways to incorporate these elements at home.

The scope of work for this project will include an analysis of existing conditions, community/stakeholder engagement, preparation of preliminary engineering plans, permitting, final engineering plans, construction, and monitoring during the establishment phase. A topographic/utility and bathymetric survey will be completed for the site and preliminary/final stormwater modeling performed to confirm the performance of the constructed wetlands. An open space management plan will be created to guide stewardship efforts and identify both short and long-term goals for vegetation establishment.

Vulnerability Assessment: The urban runoff that enters the lagoon at the project location has direct and indirect impacts on the health of the coastal marsh that has developed adjacent to the discharge point. As mentioned previously in this report, the coastal marsh is highly susceptible to future impacts from severe storms and lake level fluctuations. Addressing the urban runoff is one way to protect the health of the coastal marsh.

Resilience Strategies: Resiliency measures will include constructed wetlands to treat urban runoff, boardwalks to improve and control visitor access, educational signage, and viewing platforms for birders.

Costs: Project costs will include the following:

1. Analysis of Existing Conditions $80,000 to $100,000
2. Community/Stakeholder Engagement $15,000 to $25,000
3. Preliminary Engineering Plans $150,000 to $200,000
4. Permitting $100,000 to $150,000
5. Final Engineering Plans $250,000 to $400,000
6. Construction $2.75 million to $5 million
7. Monitoring $50,000 to $75,000

Permitting: Federal, state and local permitting will be evaluated during the engineering and design phase of the project. However, based on funding sources, potential impacts, and likely restoration activities, the permits this project will likely require are:

- NEPA compliance, likely due to receiving federal funds.
- SHPO and THPO coordination for compliance with the NHPA
- Nationwide Permit (USACE)
- 401 Water Quality Certification (ODNR)
- Shore Structure Permit (ODNR)
- Coastal Management Consistency Certification (ONDR)
- Wetland Permitting (OEPA)
- T/E Species Assessment/Review (ODNR)
- Building Permit (Conneaut)

- Stormwater Pollution Prevention Plan (Conneaut)
- Stormwater Permit (Conneaut)

Timeline: A preliminary schedule for these activities is:

1. Analysis of Existing Conditions 6 months
2. Community/Stakeholder Engagement Throughout
3. Preliminary Engineering Plans 8 months
4. Permitting 24 months
5. Final Engineering Plans 6 months
6. Construction 24 months
7. Monitoring 36 months

Anticipated Resiliency Outcome: The desired outcomes of this project include improved water quality within the harbor, 1.5 acres of added coastal marsh habitat, improved access to natural areas, educational opportunities for visitors.

Next Steps: The next steps for this project will include: pre-application meetings with regulators; bathymetric survey and topographical/utility survey of the site; stakeholder engagement; design/engineering of construction documents; stormwater modeling; preparation of nation-wide permit with ODNR; other permitting; construction of improvements; and monitoring of vegetation establishment.

5.7. Restoration Plan for Kelsey's Run Watershed

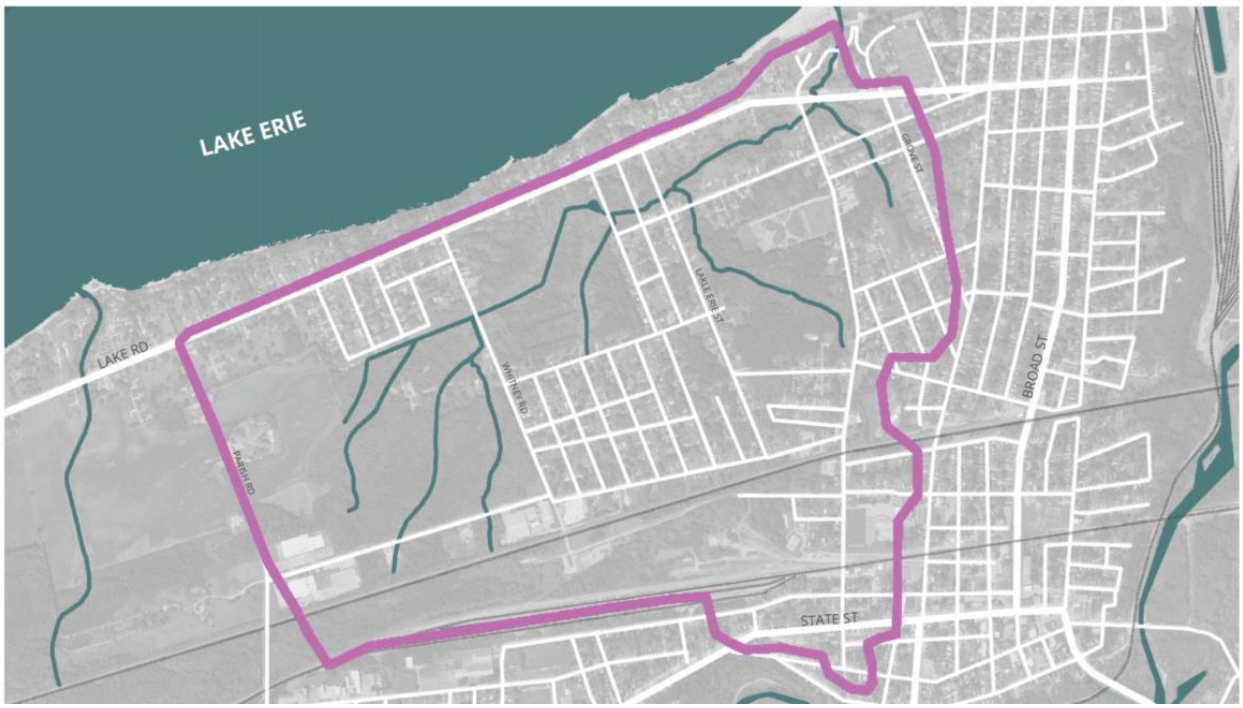


Figure 51. Kelsey's Run Watershed

Weighted MCDA Score:

GPS Coordinates: 41°57'18.37"N, 80°34'11.20"W

Background & Location: Kelsey's Run is a creek that winds through Conneaut Township Park before emptying into Lake Erie immediately west of the port. The main branch of the creek has been impounded in multiple locations but ultimately stretches about 2 miles with its headwaters near Parish Road and Chamberlain Boulevard. It drains over 1,000 acres of land. Approximately 60% of the properties in this watershed have been developed – mostly for single family residential use. All the properties, developed or not, are zoned for development by the City, with only Conneaut Township Park protected from future residential building. The City of Conneaut's Comprehensive Plan update from 2017 identifies the corridor around Kelsey's Run as an important conservation priority for protecting wetlands and riparian setbacks (City of Conneaut 2018).

The current health of the watershed is degraded due to the development of impervious surfaces, eroded banks, loss of native vegetation, and disruptions to the habitat corridor due to impoundments and buried sections of stream. Future development threatens to worsen these conditions. In addition to the loss of habitat, the direct impacts to Lake Erie water quality could be increased sediment and nutrient pollution at Conneaut Township Park Beach. The stretch of lakeside residential properties north of Lake Road are experiencing bluff erosion which may also be affected by the altered hydrology in the Kelsey's Run watershed.

Project Description & Proposed Activities: The Kelsey's Run Watershed Restoration Plan will document the current conditions in the watershed and make recommendations to the City of Conneaut for measures that will protect the stream from impacts from future development. These will likely include vegetated

setbacks, point source discharge measures, and efforts to remove impoundments and channelized or buried sections of the stream. The plan will seek to restore the natural hydrology of the watershed to the greatest extent possible. The plan will balance the needs of private property owners and future development in the area with the protection of this vital natural resource through a robust community engagement strategy. The final deliverable will be a document containing guidelines recommending best practices within the watershed that the City of Conneaut and private property owners can utilize.

The scope of work will include engagement with stakeholders such as the City of Conneaut and local property owners. Field investigations will be conducted to confirm the condition of waterways and wetlands. County GIS data and LIDAR surveys will be used to conduct a watershed analysis which will map existing features such as topography and built improvements. An alternative futures analysis will compare various approaches to protecting wetlands and riparian corridors and reveal their costs and benefits. The project will culminate in the creation of best management practices for the watershed which will suggest measures that property owners and the City of Conneaut can take to protect water quality and reduce flooding as development occurs within the watershed.

Vulnerability Assessment: Kelsey's Run has the second largest drainage area (after Conneaut Creek) in the project area. A large portion of its watershed is still underdeveloped or lightly developed. Measures to protect the drainage corridor can reduce local flooding and will have important long-term benefits to the Lake Erie water quality at Conneaut Township Park Beach.

Resilience Strategies: Resiliency measures will include riparian corridor protection measures such as vegetated setbacks, nature-based bank stabilization, stream daylighting, and removal of impoundments.

Costs: Project costs will include the following:

1. Community/Stakeholder Engagement $10,000
2. Field Investigations $20,000
3. Watershed Analysis $40,000
4. Alternative Futures Analysis $60,000
5. BMP Guide $80,000

Permitting: Federal, state and local permitting will be evaluated during the engineering and design phase of the project. However, as this proposed project is for data collection and planning activities, no permits will likely be required.

Timeline: A preliminary schedule for these activities is:

1. Community/Stakeholder Engagement 2 months
2. Field Investigations 1 month
3. Watershed Analysis 3 months
4. Alternative Futures Analysis 3 months
5. BMP Guide 4 months

Anticipated Resiliency Outcome: The desired outcomes of this project include a comprehensive plan to encourage best management practices within the Kelsey Run watershed to reduce flooding and improve the Lake Erie water quality at Conneaut Township Park Beach.

Next Steps: The next steps for this project will include: meetings with the City of Conneaut; stakeholder engagement; collection of field data; development of a watershed analysis; preparation of alternative futures analysis to compare various protection measures in the watershed; creation of best management practices (BMP's) for Kelsey's Run Watershed.

5.8. Bank Stabilization at Kelsey's Run

Figure 52. Bank Stabilization at Kelsey's Run

Weighted MCDA Score:

GPS Coordinates: 41°57'43.62"N, 80°33'52.40"W

Background & Location: Kelsey's Run is a creek that winds through Conneaut Township Park before emptying into Lake Erie immediately west of the port. The main branch of the creek has been impounded in multiple locations but ultimately stretches about 2 miles with its headwaters near Parish Road and Chamberlain Boulevard. It drains over 1,000 acres of land. One of the most visited sections of the creek is at its mouth where it enters Lake Erie. This quarter mile section runs through Conneaut Township Park, dropping 15 feet in elevation before reaching the beach and Lake Erie. The area immediately surrounding the creek is mostly vegetated with turfgrass. The banks are deeply incised and are eroding in many places. During stakeholder meetings with Conneaut Township Park representatives, they informed the design team that the beach has been closed in the past due to water quality issues. They also expressed concern that stormwater runoff from the adjacent road surfaces may be eroding the creek's banks.

Project Description & Proposed Activities: The Bank Stabilization Project at Kelsey's Run will restore 1,200 feet of highly visible stream bank. It will serve as a pilot project that will inform future restoration measures in the watershed. Nature-based solutions to bank stabilization will be employed and native vegetation re-established in this stretch of the creek. The project will include educational signage to inform visitors about the benefits of the restoration for water quality and wildlife habitat.

The scope of work for this project will include an analysis of existing conditions, community/stakeholder engagement, preparation of preliminary engineering plans, permitting, final engineering plans, construction, and monitoring during the establishment phase. A topographic/utility survey will be performed to establish existing conditions. Fluvial modelling will be conducted to predict the behavior of the stream during various conditions/seasons.

Vulnerability Assessment: The vulnerability of this stretch of Kelsey's Run is currently low, but that may change with future development upstream. This project location is very visible to patrons of the park and would make a good pilot location with high educational value.

Resilience Strategies: Resiliency measures will include nature-based bank stabilization strategies, conversion of turfgrass to native plantings, reduction of suspended sediments into Kelsey's run and Lake Erie, and educational signage.

Costs: Project costs will include the following:

1.	Analysis of Existing Conditions	$15,000
2.	Community/Stakeholder Engagement	$5,000
3.	Preliminary Engineering Plans	$20,000
4.	Permitting	$5,000
5.	Final Engineering Plans	$70,000
6.	Construction	$250,000 to $300,000
7.	Monitoring	$10,000

Permitting: Federal, state and local permitting will be evaluated during the engineering and design phase of the project. However, based on funding sources, potential impacts, and likely restoration activities, the permits this project will likely require are:

- NEPA compliance, likely due to receiving federal funds.
- SHPO and THPO coordination for compliance with the NHPA
- Wetland Permitting (OEPA)
- T/E Species Assessment/Review (ODNR)
- Floodplain Permitting (Ashtabula County)
- Building Permit (Conneaut)
- Stormwater Pollution Prevention Plan (Conneaut)

Timeline: A preliminary schedule for these activities is:

1.	Analysis of Existing Conditions	3 months
2.	Community/Stakeholder Engagement	Throughout
3.	Preliminary Engineering Plans	3 months
4.	Permitting	3 months
5.	Final Engineering Plans	4 months
6.	Construction	6 months
7.	Monitoring	36 months

Anticipated Resiliency Outcome: The desired outcomes of this project include bank stabilization, the addition of ½ acre of native plantings, reduction in suspended solids into Kelsey's Run, and education of best management practices to visitors of the park.

Next Steps: The next steps for this project will include: pre-application meetings with regulators; topographical/utility survey of the site; fluvial modelling of the stream flows; stakeholder engagement; design/engineering of construction documents; preparation of permits; construction of improvements; and monitoring of vegetation establishment.

5.9. Conneaut Creek Shoreline Restoration

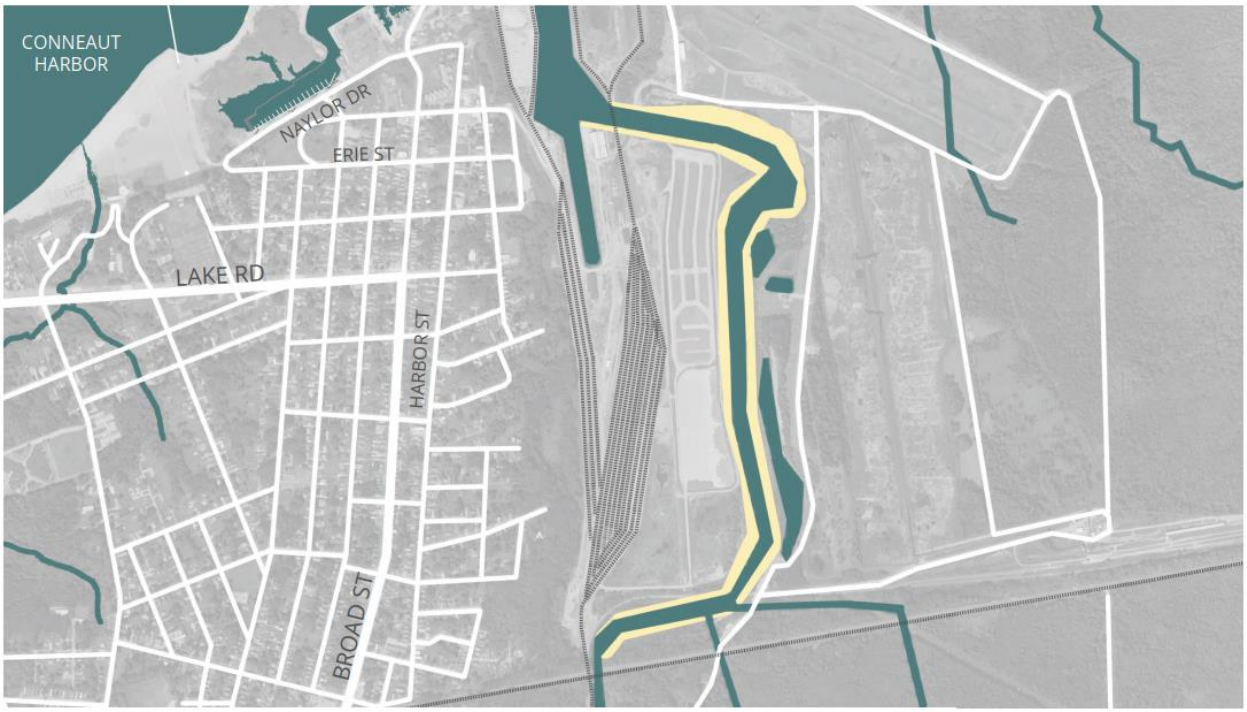


Figure 53. Conneaut Creek Restoration

Weighted MCDA Score:

GPS Coordinates: 41°57'54.83"N, 80°32'45.14"W

Background & Location: Conneaut Creek is one of the most important natural resources for the Conneaut Region. According to the Ohio Department of Natural Resources, "Conneaut Creek offers an exceptional diversity of habitats that support outstanding wildlife populations. The stream corridor is home to 78 fish species and 32 species of amphibians and reptiles. The heavily wooded watershed harbors more than 30 unique plants and plant communities, many of which are listed as federally and state threatened or endangered" (ODNR [n.d.]). The creek is particularly popular with anglers who travel to the Conneaut region for the steelhead trout in the creek. Over 16 miles of the creek starting at the state line are protected by Ohio with designation as a Wild River. An additional 21 miles downstream are designated as a scenic river. These designations end at the historic "Arches" bridge which carries the Penn Central Railroad over the waterbody at river mile 2.0.

The creek downstream of the Arches bridge empties into Lake Erie at the Conneaut Port. This stretch of creek is heavily industrialized with the land on either side almost entirely owned by Canadian National Railroad. This stretch of creek is also the only portion of the creek within the State of Ohio that doesn't meet full attainment of water quality standards for exceptional warm water habitat. The Ohio EPA lists the causes of impairment in this area as priority organics, metal, and other habitat alterations (ODNR

2005). The sources of impairment are primarily stream bank modification (dredging), stream bank destabilization (development) and landfills.

The major threats to Conneaut Creek include a coal handling facility and modification of the river by channelization and steel bulkheading of the riverbanks near the mouth of the creek. The lower 2 miles of Conneaut Creek have been impacted from industrial activities. Over the last mile, a major coal handling operation has resulted in extensive layers of coal dust in the substrates. During a stakeholder breakout session, representatives from Canadian National Railroad informed the team that bank erosion is threatening the stability of the north abutment wall at their most downstream rail bridge crossing.

Project Description & Proposed Activities: The Conneaut Creek Shoreline Restoration project will stabilize the stream bank within a 2-mile industrial corridor using nature-based stabilization strategies. The scope of work will include a field inspection of the shoreline conditions within the project area. Using this reconnaissance, multiple project sites will be selected based upon the effectiveness of nature-based stabilization techniques and the potential benefits to the environment and critical infrastructure. Further site investigations will be conducted at the selected sites. This will entail both an above ground survey as well as a bathymetric survey of below water conditions. Fluvial modelling will be conducted to predict the behavior of the stream during various conditions/seasons. Final design/engineering plans will be prepared for the selected sites and restoration measures constructed.

The scope of work for this project will include: an analysis of existing conditions; field inspections of bank conditions; project site selection; topographic/bathymetric surveys; fluvial modelling; stakeholder engagement; preparation of preliminary/final engineering plans; permitting; construction/ and monitoring during the establishment phase.

Vulnerability Assessment: Conneaut Creek is one of this region's most valuable natural resources. This stretch of the creek is much more hydrologically connected to Lake Erie water levels being so close to the mouth. As such, it is much more vulnerable to future fluctuations in water levels.

Resilience Strategies: Resiliency measures will include recommendations for implementing nature-based strategies for bank stabilization.

Costs: Project costs will include the following:

1.	Analysis of Existing Conditions	$50,000
2.	Stakeholder Engagement	$10,000
3.	Site Selection	$25,000
4.	Engineering Plans	$140,000
5.	Permitting	$75,000
6.	Construction	$1.5 million to $2 million
7.	Monitoring	$50,000

Permitting: Federal, state and local permitting will be evaluated during the engineering and design phase of the project. However, based on funding sources, potential impacts, and likely restoration activities, the permits this project will likely require are:

- NEPA compliance, likely due to receiving federal funds.
- SHPO and THPO coordination for compliance with the NHPA
- Nationwide Permit (USACE)
- 401 Water Quality Certification (ODNR)

- Shore Structure Permit (ODNR)
- Coastal Management Consistency Certification (ONDR)
- Wetland Permitting (OEPA)
- T/E Species Assessment/Review (ODNR)
- Building Permit (Conneaut)

Timeline: A preliminary schedule for these activities is:

1.	Analysis of Existing Conditions	4 months
2.	Stakeholder Engagement	1 month
3.	Site Selection	1 month
4.	Engineering Plans	4 months
5.	Permitting	6 months
6.	Construction	12 months
7.	Monitoring	36 months

Anticipated Resiliency Outcome: The desired outcomes of this project will include a report recommending locations for nature-based shoreline stabilization practices along Conneaut Creek.

Next Steps: The next steps for this project will include: pre-application meetings with regulators; stakeholder engagement; topographical/bathymetric survey of the site; field inspection; fluvial modelling of the stream flows; site selection; design/engineering of construction documents; preparation of permits; construction of improvements; and monitoring of vegetation establishment.

5.10. Bluff Protection in Reach 10

Figure 54. Bluff Protection in Reach 10

Weighted MCDA Score:

GPS Coordinates: East Boundary - 41°57'51.20"N, 80°33'38.34"W; West Boundary - 41°57'7.93"N, 80°38'49.33"W

Background & Location: Residential properties west of Conneaut's port are situated along bluffs that reach a height of 40 to 65 feet. Erosion remains a persistent issue throughout this section of the shoreline, largely driven by two interrelated factors: a lack of protective beaches and the presence of excess surface runoff and groundwater within the bluff. Waves continuously attack the base, or toe, of the bluff, leading to undercutting. Simultaneously, water infiltration from precipitation and groundwater flow weakens the upper layers, causing instability and slumping—even in areas with structural or natural toe protection.

The geology of the bluffs consists mainly of glacial till at their base, topped by layers of glaciolacustrine silts, sands, and clays (Lewis, Barnett, Todd 2023). Nearshore, the lakebed consists of shale bedrock covered by a thin layer of sand and gravel. Beach presence along this reach is minimal and generally confined to areas where human-made structures interrupt the natural flow of sediment. Notable examples include the beaches near Conneaut Waterworks and the more substantial accumulation at Conneaut Township Park, both influenced by the eastern breakwater's interference with littoral drift.

The ODNR Division of Geological Survey has documented changing bluff recession rates along Ohio's Lake Erie shoreline across several decades. Data from 1990 to 2004 shows average rates ranging from 0 to 4.7 feet per year (Jones 2022). While much of the area experienced minimal erosion—around 0 to just over 1 foot per year—the highest recession occurred near Margor Drive, particularly east of a barge used for shoreline protection, where rates reached up to 4.7 feet annually (Jones 2022).

Residents in this area attended public meetings hosted for this project and voiced strong concerns about the threat that bluff erosion posed to their homes and properties.

Project Description & Proposed Activities: The Bluff Protection in Reach 10 project will investigate local conditions within the reach and engage local property owners to identify measures that they can take to reduce their risk of property loss and damage. The project will educate property owners on the processes contributing to bluff instability and arm them with resources to address their local conditions where possible. These could involve such measures as revetments to protect the toe of the bluffs, re-grading of the bluffs, groundwater management, native planting on the slopes, redirecting surface water runoff, or property relocation. It may also include a public/private partnership similar to what residents in the City of Euclid entered into whereby private property owners granted public easements on their property in order to fund stabilization projects.

The scope of work will include an analysis of existing conditions, community and stakeholder engagement, and preparation of a detailed report documenting measures that property owners can take to stabilize the bluffs and protect their properties.

Vulnerability Assessment: The high bluffs to the west of Conneaut's harbor are very susceptible to erosion from severe storm events and erosion of the lake bed.

Resilience Strategies: Resiliency measures will include recommendations for revetments to protect the toe of the bluffs, re-grading of the bluffs, groundwater management, native planting on the slopes, redirecting surface water runoff, or property relocation.

Costs: Project costs will include the following:

1. Analysis of Existing Conditions $35,000
2. Community/Stakeholder Engagement $25,000
3. Bluff Protection Report $60,000

Permitting: Federal, state and local permitting will be evaluated during the engineering and design phase of the project. However, as this proposed project is for data collection and planning activities, no permits will likely be required.

Timeline: A preliminary schedule for these activities is:

1. Analysis of Existing Conditions 3 months
2. Community/Stakeholder Engagement 3 months
3. Bluff Protection Report 6 to 12 months

Anticipated Resiliency Outcome: The desired outcomes of this project include education to property owners along Lake Erie and ultimately stabilization of bluffs through a variety of measures on individual private property.

Next Steps: The next steps for this project will include: stakeholder and public agency engagement; analysis of existing conditions; and preparation of a report recommending actions to protect the bluff.

5.11. Turkey Creek Bluff, Ravine, and Riparian Stabilization

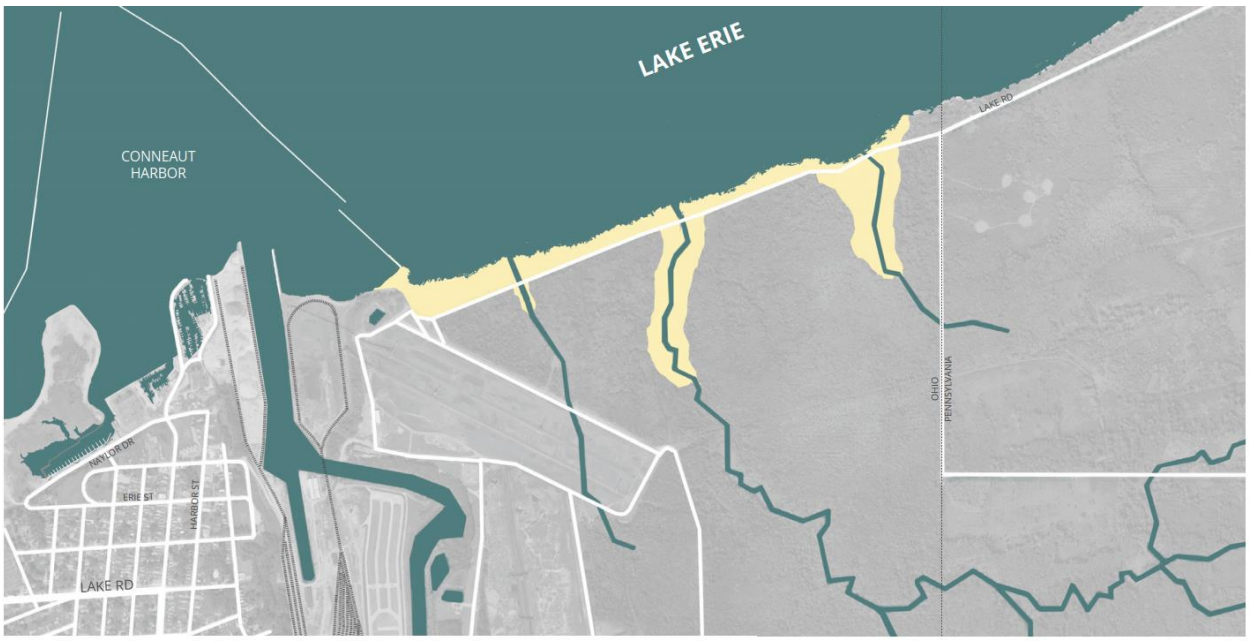


Figure 55. Turkey Creek Stabilization

Weighted MCDA Score:

GPS Coordinates: 41°58'26.12"N, 80°31'51.86"W

Background & Location: Turkey Creek Metropark spans 602 acres along Thompson Road and Lake Road in Conneaut, Ohio, marking the northeastern tip of the state. Due to its remote location, the area remains largely difficult to access. The park includes 236 acres of forested wetlands, supports rare plant and wildlife species, and offers three miles of Turkey Creek shoreline—renowned for its exceptional trout fishing (Ashtabula County Metroparks 2017). The park is situated within an undeveloped section of the Lake Erie shoreline. Here the bluffs, which can reach heights of up to 40 feet, are composed of glacial till overlain by layers of glaciolacustrine clay, silt, and sand. Offshore, the shale bedrock is thinly covered with sand and gravel.

One notable feature in the center of this reach is Turkey Creek. Flanking both sides of the creek mouth, sand accumulations are present, providing some shoreline material. However, elsewhere along this stretch, beaches are either very narrow or vanish entirely during periods of high lake levels. The absence of shoreline structures, combined with limited beach width, leaves the area vulnerable to active erosion (ODNR 2020a). Wave action aggressively erodes the base of the bluffs, while excess surface and groundwater at the top compromise soil stability. This leads to slumping or mass sliding of the upper bluff layers, accelerating the retreat of the shoreline (ODNR 2020a). The ODNR Division of Geological Survey has tracked shoreline recession along Ohio's Lake Erie coast, with notable changes over time due to coastal development and fluctuating lake levels. From 1990 to 2004, recession rates in this area decreased from previous highs but still ranged from 0 to 5.3 feet per year (Jones 2022). The most significant erosion remained concentrated just east of the Conneaut Harbor breakwater, where rates exceeded 1 foot and peaked at 5.3 feet annually.

During breakout sessions with staff from Ashtabula County Metroparks, they reported severe erosion events occurring on the bluffs just to the east of Turkey Creek resulting in the washing out of Lake Road. They also reported erosion issues in several of the minor ravines along the shoreline.

Project Description & Proposed Activities: The Turkey Creek Bluff, Ravine, and Riparian Stabilization project will use nature-based strategies to restore up to 2,000 feet of lakeside bluff as well as an additional 1,200 feet of riparian and ravine environments.

The project will begin with close coordination with Ashtabula County Metroparks and other stakeholders. A pre-application meeting with regulators will then be held. Field investigations will be conducted to confirm existing conditions. Using this reconnaissance, multiple project sites will be selected based upon the effectiveness of nature-based stabilization techniques at each area and the potential benefits to the environment and critical infrastructure. Further site investigations will be conducted at the selected sites. This will entail both an above ground survey as well as a bathymetric survey of below water conditions. Fluvial modelling will be conducted to predict the behavior of Turkey Creek during various conditions/seasons. Final design/engineering plans will be prepared for the selected sites and restoration measures constructed.

The scope of work for this project will include: an analysis of existing conditions; field inspections of bluff, ravine, and riparian conditions; project site selection; topographic/bathymetric surveys; fluvial modelling; stakeholder engagement; preparation of preliminary/final engineering plans; permitting; construction/ and monitoring during the establishment phase.

Vulnerability Assessment: The bluffs and ravines east of Conneaut Harbor are very susceptible to erosion from future severe storm events and the lowering of the lake bed.

Resilience Strategies: Resiliency measures will include bluff stabilization measures such as groundwater management, native plantings, and revetments, as well as ravine and riparian corridor restoration through nature-based stabilization strategies.

Costs: Project costs will include the following:

1.	Analysis of Existing Conditions	$60,000
2.	Stakeholder Engagement	$15,000
3.	Site Selection	$25,000
4.	Engineering Plans	$160,000
5.	Permitting	$90,000
6.	Construction	$1.75 million to $2.25 million
7.	Monitoring	$60,000

Permitting Federal, state and local permitting will be evaluated during the engineering and design phase of the project. However, based on funding sources, potential impacts, and likely restoration activities, the permits this project will likely require are:

- NEPA compliance, likely due to receiving federal funds.
- SHPO and THPO coordination for compliance with the NHPA
- Nationwide Permit (USACE)
- 401 Water Quality Certification (ODNR)
- Shore Structure Permit (ODNR)

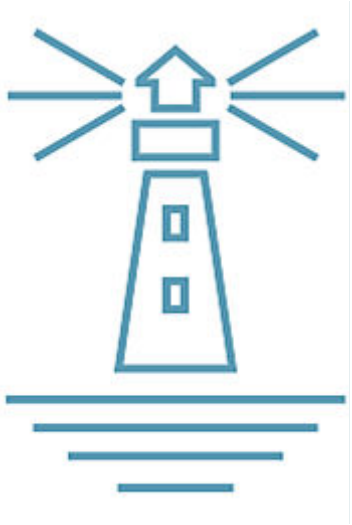
- Coastal Management Consistency Certification (ONDR)
- Wetland Permitting (OEPA)
- T/E Species Assessment/Review (ODNR)
- Building Permit (Conneaut)
- Stormwater Pollution Prevention Plan (Conneaut)

Timeline: A preliminary schedule for these activities is:

1.	Analysis of Existing Conditions	6 months
2.	Stakeholder Engagement	1 month
3.	Site Selection	1 month
4.	Engineering Plans	6 months
5.	Permitting	8 months
6.	Construction	16 months
7.	Monitoring	36 months

Anticipated Resiliency Outcome: The desired outcomes of this project will include recommended actions to Ashtabula County Metroparks for stabilizing Turkey Creek as well as the bluffs and ravines in Turkey Creek Metropark.

Next Steps: The next steps for this project will include: pre-application meetings with regulators; stakeholder engagement; topographical/bathymetric survey of the site; field inspection; fluvial modelling of the stream flow; site selection; design/engineering of construction documents; preparation of permits; construction of improvements; and monitoring of vegetation establishment.



Chapter 6. Monitoring & Adaptive Management

6. Monitoring & Adaptive Management

(Section to be finalized)

1.1. Monitoring

The Project aims to establish aquatic, wetland, and upland habitats that function naturally and sustain themselves with minimal ongoing intervention. While the goal is to minimize the need for human involvement, ecosystems are inherently dynamic, and even well-designed habitats often require initial and occasional adjustments to reach their full ecological potential and align with natural systems.

The length of post-construction monitoring should be determined through collaboration with stakeholders and regulatory agencies, such as the USACE and OH EPA, to ensure sufficient time to evaluate habitat outcomes. Ideally, the monitoring period will extend until the restored habitats demonstrate they have met predetermined benchmarks. These benchmarks, defined as measurable physical, chemical, or biological attributes, provide a framework for assessing whether project goals have been achieved.

Regulatory permits for habitat restoration projects typically mandate monitoring periods of up to five years, capturing the phases of rapid ecological change and subsequent stabilization. However, for complex or large-scale projects, a longer timeframe may be necessary to adequately document progress and ensure habitat functionality.

Key aspects of the monitoring program will be designed in partnership with resource agencies and stakeholders. These aspects include:

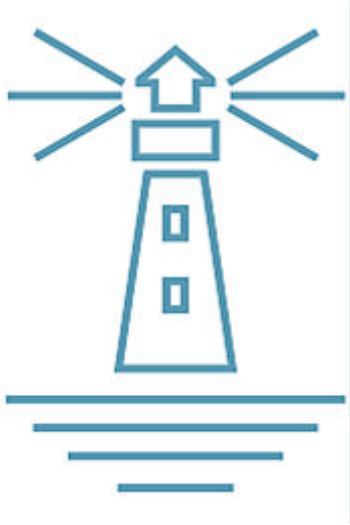
- Evaluation Metrics: Specific indicators, such as water quality, vegetation density, or species diversity, to track habitat performance.
- Success Standards: Defined objectives against which project outcomes are measured.
- Monitoring Locations: Strategically placed sites to collect representative data.
- Data Protocols: Guidelines for managing, analyzing, and reporting findings to support informed decision-making and adaptive management.

By embedding a comprehensive and adaptable monitoring framework, the Project can ensure that its habitats are resilient, effective, and aligned with ecological restoration goals, even in the face of unforeseen challenges.

1.2. Adaptive Management

Project proponents should collaborate with regulatory agencies and project partners to develop and implement an Adaptive Management Plan. Unlike traditional ecosystem management, adaptive management acknowledges and prepares for uncertainties, natural variability, and unforeseen disturbances. When integrated at the outset of post-construction monitoring, this approach allows for early detection of deviations from the expected restoration trajectory, enabling timely corrective actions to address issues or deficiencies.

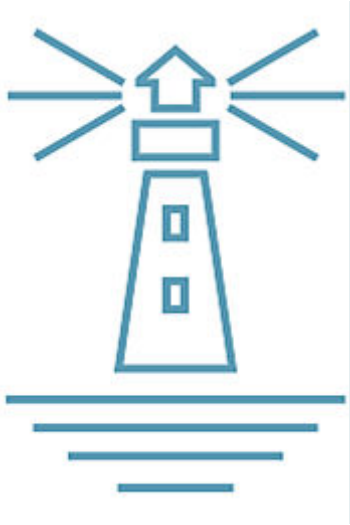
If post-construction monitoring reveals that habitat components of the project are not meeting pre-established performance standards, the underlying causes of failure will be evaluated, and corrective measures will be proposed to resolve the shortcomings. Should it be determined that the original performance standards are unattainable, revised standards may be developed to reflect realistic outcomes. Adaptive management necessitates a long-term commitment to monitoring and iterative adjustments,ensuring restoration projects achieve their intended success and deliver maximum functional benefits over time.



Chapter 7. Conclusions & Recommendations

7. Conclusions & Recommendations

(This section will be written after the next round of stakeholder and public meetings)



Literature Cited

Literature Cited

Alliance for the Great Lakes. (n.d.). Lake Erie algae blooms. https://greatlakes.org/campaigns/lake-erie-algae-blooms/

Anderson, E.J., Stow, C.A., Gronewold, A.D. et al. (2021) *Seasonal overturn and stratification changes drive deep-water warming in one of Earth's largest lakes.* Nat Commun 12, 1688. https://doi.org/10.1038/s41467-021-21971-1

Ashtabula County. (2013). *Ashtabula County Coastal Management Plan*. https://www.ashtabulacounty.us/DocumentCenter/View/865

Ashtabula County Metroparks. (2017). *Turkey Creek*. https://ashtabulametroparks.com/turkey-creek/

Buonaiuto, F. (n.d.). *Coastal landforms and processes* [PowerPoint presentation]. Hunter College. http://www.geo.hunter.cuny.edu/~fbuon/GEOL_231/Lectures/Coastal%20Geomorphology.pdf

Channell, K., DelPizzo, J., Briley, L., Rood, R., Jorns, J., Hutchens, K. (2022). *Lake Erie: a Summary of Anticipated Future Climate Conditions*. Great Lakes Integrated Sciences and Assessments. https://glisa.umich.edu/lake-erie-retrospective/

City of Conneaut (2018, January). *City of Conneaut 2017 Comprehensive Plan Update.* https://www.conneautohio.gov/Document%20Center/Department/Planning%20&%20zoning/ConneautCompPlan-Final%20Draft-2018-1.pdf

Cosier, S. (2022). *How floating wetlands are helping to clean up urban waters.* Yale Environment 360. https://e360.yale.edu/features/floating-wetlands-cities-pollution

Crehan, R. (n.d.). *LCFWCO – Wetland restoration site before and after* [Photograph]. U.S. Fish and Wildlife Service. https://www.fws.gov/media/lcfwco-wetland-restoration-site-and-after

d'Orgeville, M., W. R. Peltier, A. R. Erler, and J. Gula. (2014). *Climate change impacts on Great Lakes Basin precipitation extremes*. J. Geophys. Res. Atmos., 119, 10,799–10,812, doi:10.1002/2014JD021855.

Dorothy, O. (2020). Healthy floodplains reduce nutrient pollution. *Water Online*. https://www.wateronline.com/doc/healthy-floodplains-reduce-nutrient-pollution-0001

Dietz, T., & Zhao, J. (2011). Paths to climate cooperation. *Proceedings of the National Academy of Sciences, 108*(38), 15671–15672. https://doi.org/10.1073/pnas.1112844108

Draper, D. (2019, July 15). *Lake Erie at risk – Buffalo, New York area congressman calls for swift action to address threat to health of Great Lakes*. Niagara At Large. https://niagaraatlarge.com/2019/07/15/lake-erie-at-risk-buffalo-new-york-area-congressman-calls-for-swift-action-to-address-threat-to-health-of-great-lakes/

eBird. (2021). eBird Checklist: https://ebird.org/ebird/view/checklist/S36954356. eBird: An online

database of bird distribution and abundance [web application]. Cornell Lab of Ornithology, Ithaca, New York. Available: http://www.ebird.org.

Environment and Climate Change Canada and the U.S. Environmental Protection Agency. (2021). *Lake Erie Lakewide Action and Management Plan, 2019-2023*. https://binational.net/wp-content/uploads/2021/11/EN-2019-2023-Lake-Erie-LAMP.pdf

Erickson, J. (2012, May 3). Construction of new rock spawning reefs will help Great Lakes native fish. *University of Michigan News / Phys.org*. https://phys.org/news/2012-05-spawning-reefs-great-lakes-native.html

Great Lakes Integrated Sciences and Assessments (GLISA). (2022). *2021 Annual climate trends and impacts summary for the Great Lakes basin*. https://glisa.umich.edu/wp-content/uploads/2022/07/2021-Climate-Trends-and-Impacts-Summary.pdf

Great Lakes Integrated Sciences and Assessments (GLISA). (2025). *Algal blooms*. University of Michigan. https://glisa.umich.edu/resources-tools/climate-impacts/algal-blooms/

Great Lakes Restoration Initiative. (2024, March 5). *Port Clinton Coastal Restoration Project restores coastal wetland along Ohio's Lake Erie shoreline*. https://www.glri.us/news/port-clinton-coastal-restoration-project-restores-costal-wetland-along-ohios-lake-erie

Hapke, C. J., Malone, S., & Kratzmann, M. (2009). *National assessment of historical shoreline change: A pilot study of historical coastal bluff retreat in the Great Lakes, Erie, PA* (Open-File Report 2009–1042). U.S. Geological Survey. https://pubs.usgs.gov/of/2009/1042/

Johnson, L., de Loë, R., Lofgren, B., Packman, A., Seglenieks, F., Sharma, A., Sohngen, B., Tiboris, M., Vimont, D., Wilson, R., Kunkel, K., & Ballinger, A. (2019). *An assessment of the impacts of climate change on the Great Lakes* (Report). Environmental Law & Policy Center. https://elpc.org/wp-content/uploads/2020/04/2019-ELPCPublication-Great-Lakes-Climate-Change-Report.pdf

Jones, J. S. (2022). *Analyses of Lake Erie coastal recession: Ohio Department of Natural Resources, Division of Geological Survey, Open-File Report OFR 2022-3*. Ohio Department of Natural Resources. Retrieved June 13, 2025, from https://dam.assets.ohio.gov/image/upload/ohiodnr.gov/documents/geology/OFR2022_3_Jones_2022.pdf

Jones, M. (2019). Rising water levels in North America's Great Lakes. *Journal of Environmental Studies*, 45(3), 234–250. https://doi.org/10.1234/jes.2019.03456

Kent State University. (2014). *Conneaut Ohio: Charrette Report*. Clevland Urban Design Collaborative. https://www.cudc.kent.edu/charrette.

Lewis, C. F. M., Cameron, G. D. M., Barnett, P. J., & Todd, B. J. (2023). Onshore–offshore correlation of central Lake Erie glacial deposits. *Canadian Journal of Earth Sciences, 60*(10), 1404–1427. https://doi.org/10.1139/cjes-2023-0017

Mackey, S. D., 2012: Great Lakes Nearshore and Coastal Systems. In: U.S. National Climate Assessment Midwest Technical Input Report. J. Winkler, J. Andresen, J. Hatfield, D. Bidwell, and D. Brown, coordinators. Available from the Great Lakes Integrated Sciences and Assessments (GLISA) Center, http://glisa.msu.edu/docs/NCA/MTIT_Coastal.pdf.

Massachusetts Division of Fisheries and Wildlife. (n.d.). *Restore and protect natural shorelines: Use living shoreline techniques*. Climate Action Tool. https://climateactiontool.org/content/restore-and-protect-natural-shorelines-use-living-shoreline-techniques

Milwaukee Metropolitan Sewerage District (MMSD). (n.d.). *Sustainability*. https://www.mmsd.com/what-we-do/sustainability

Mongiovi, R. (2023, April 24). Erosion poses costly questions for Lake Erie landowners in Pennsylvania, Ohio, New York. *GoErie*. https://www.goerie.com/story/news/environment/2023/04/24/erosion-poses-costly-questions-for-lake-erie-landowners-in-pennsylvania-ohio-new-york/69876698007/

National Audubon Society. (2025). *Conneaut Harbor Important Bird Area.* https://birdinghotspots.org/iba/conneaut-harbor

National Oceanic and Atmospheric Administration (NOAA). (2015, October). *Guidance for Considering the Use of Living Shorelines*. https://coastalscience.noaa.gov/news/noaa-releases-guidance-for-the-use-of-living-shorelines/

New York Times. (2017, October 3). *Lake Erie.* https://www.nytimes.com/interactive/2017/10/03/science/earth/lake-erie.html

Ohio Environmental Protection Agency (OEPA). (n.d.). *Missions and Values*. https://epa.ohio.gov/about/mission-and-values

Ohio Department of Natural Resources (ODNR). (n.d.). *Conneaut Creek Wild and Scenic River*. https://ohiodnr.gov/go-and-do/plan-a-visit/find-a-property/conneaut-creek-wild-and-scenic-river

ODNR. (July 2005). *Conneaut Creek Wild and Scenic River Designation Study; A study of the Conneaut Creek for inclusion into Ohio's Scenic Rivers System*. https://dam.assets.ohio.gov/image/upload/ohiodnr.gov/documents/natural-areas/SR-studies/ConneautSRStudy.pdf

ODNR. (2011). *Ohio Coastal Design Manual: Guidance for Professionals Designing Structures Along Lake Erie*. https://ohiodnr.gov/discover-and-learn/safety-conservation/about-ODNR/coastal-management/ohio-coastal-mgmt-program/coastal-design-manual.

ODNR. (2018). *Ohio Coastal Atlas, Third Edition.* https://ohiodnr.gov/discover-and-learn/safety-conservation/about-odnr/coastal-management/ohio-coastal-mgmt-program/ohio-coastal-atlas-documents

ODNR. (2020a). *Lake Erie Shore Erosion Management Plan (LESEMP)*. https://ohiodnr.gov/discover-and-learn/safety-conservation/about-ODNR/coastal-management/coastalpropertyowners/LESEMP-documents

ODNR (2020b). *The Ice Age in Ohio*. https://ohiodnr.gov/discover-and-learn/safety-conservation/about-ODNR/geologic-survey/glacial-geology/ice-age-in-ohio

ODNR. (2023a). *Ashtabula County state listed animal species.* https://dam.assets.ohio.gov/image/upload/ohiodnr.gov/documents/wildlife/state-listed-species/ashtabula.pdf

ODNR. (2023b). *Ashtabula County state-listed plant species.* https://dam.assets.ohio.gov/image/upload/ohiodnr.gov/documents/natural-areas/species/Ashtabula.pdf

ODNR. (2025). *Welcome to the Lake Erie Birding Trail*. https://ohiodnr.gov/go-and-do/see-the-sights/lake-erie-birding-trail

Ohio Ornithological Society. (n.d.). Birding at Conneaut Harbor. from https://ohiobirds.org/birding-at-conneaut-harbor/

Ohio Sea Grant College Program. (1997). *Lake Erie's artificial reef program* (OHSU-FS-021). The Ohio State University. https://ohioseagrant.osu.edu/archive/_documents/publications/FS/FS-021%20Lake%20Erie's%20artificial%20reef%20program.pdf

O'Neill, M. (2019, June 24). Sand replenishment underway. *GoErie*. https://www.goerie.com/story/lifestyle/presque-isle/2019/06/24/sand-replenishment-underway/4836842007/

Ohio Revised Code § 1710.02 (2023). In *Ohio Revised Code – Title XVII: Corporations–Partnerships Chapter 1710 – Special Improvement Districts*. Retrieved June 13, 2025, from https://codes.ohio.gov/ohio-revised-code/section-1710.02

Roloson, S. (2005, July). *Conneaut Creek Wild and Scenic River designation study* (ODNR Division of Natural Areas and Preserves). Ohio Department of Natural Resources. https://dam.assets.ohio.gov/image/upload/ohiodnr.gov/documents/natural-areas/SR-studies/ConneautSRStudy.pdf

Saunders, S. (2023). Great Lakes Piping Plovers are flying high with a second record-breaking breeding season. *Audubon Great Lakes*. https://gl.audubon.org/news/sharing-love-great-lakes-piping-plovers-one-beachgoer-time

Save Our Native Species Inc. (n.d.). *S.O.N.S. of Lake Erie Fishing Club*. https://sonsoflakeerie.org/habitat.htm

Shields, M. (2018, March 12). Manufacturing a high-wage Ohio. The Century Foundation. https://tcf.org/content/report/manufacturing-high-wage-ohio/

Sinha, S. K., Neeraja, S., Price, T. H., & Wolf, A. (2023, March). Climate change

preparedness of Great Lakes communities (Report, 22 pp.). Environmental Consulting & Technology, Inc. https://www.risc.solutions/wp-content/uploads/2023/03/RISC-RainFall-and-Permits-Report-March-2023.pdf?v=3

Smith, J. A., & Lee, R. T. (2020). *Climate change and regional ecosystems*. University Press.

Tunney, C. (2017, June 19). Great features of the Great Lakes region: Ohio. *Great Lakes Echo*. https://greatlakesecho.org/2017/06/19/great-features-of-the-great-lakes-region-ohio/

U.S. Climate Resilience Toolkit. (n.d.). *Great Lakes* https://toolkit.climate.gov/region/great-lakes

U.S. Army. (2024). *Great Lakes coastal wetland revitalized on Ohio's Lake Erie shoreline*. https://www.army.mil/article/280461/great_lakes_costal_wetland_revitalized_on_ohios_lake_erie_shoreline

United States Army Corps of Engineers (USACE). (2003). *Living on the coast: protecting investments in shore property on the Great Lakes.* Detroit : Madison :U.S. Army Corps of Engineers, Detroit District ; Sea Grant, University of Wisconsin. https://ijc.org/en/lsbc/living-coast-protecting-investments-shore-property

U.S. Army Corps of Engineers. (2007). *How beach nourishment works*. U.S. Army Corps of Engineers, North Atlantic Division. https://www.nap.usace.army.mil/Portals/39/docs/Civil/Coastal/HowBeachNourishmentWorks_Web.pdf

USACE. (2022). *Environmental evaluation and management of dredged material for beneficial use: A regional beneficial use testing manual for the Great Lakes* (ERDC-EL TR-22-9). U.S. Army Corps of Engineers. https://budm.el.erdc.dren.mil/guidance/BUDM_GL_Manual_ERDC-EL_TR-22-9.pdf

USACE. (2024, August). *Conneaut Harbor, Ohio: Operations and maintenance fact sheet*. U.S. Army Corps of Engineers, Great Lakes and Ohio River Division. https://lre-ops.usace.army.mil/OandM/factsheets/ConneautHarbor.pdf

United States Environmental Protection Agency (EPA). (2021, July 4). *Watershed report: Conneaut Creek*. https://watersgeo.epa.gov

EPA (2003). *Protecting water quality from urban runoff* (EPA 841-F-03-003). https://www3.epa.gov/npdes/pubs/nps_urban-facts_final.pdf

EPA. (2025, March 17). *Great Lakes facts and figures*. https://www.epa.gov/greatlakes/great-lakes-facts-and-figures

EPA. (2025b). *Climate Change Indicators: Great Lakes Water Levels and Temperatures.* https://www.epa.gov/climate-indicators/great-lakes#:~:text=Over%20the%20last%20few%20decades,all%20of%20the%20Great%20Lakes.

U.S. Federal Government. (2024, April 8). U.S. Climate Resilience Toolkit. [Online] https://toolkit.climate.gov.

U.S. Global Change Research Program (USGCRP). (2018). *Impacts, risks, and adaptation in the United States: Fourth National Climate Assessment, Volume II: Report-in-brief* (D. R. Reidmiller, C. W. Avery, D. R. Easterling, K. E. Kunkel, K. L. M. Lewis, T. K. Maycock, & B. C. Stewart, Eds.). https://doi.org/10.7930/NCA4.2018

Wilcox, D. A., & Whillans, T. H. (1999). Techniques for restoration of disturbed coastal wetlands of the Great Lakes. *Wetlands, 19*(4), 835–857. https://doi.org/10.1007/BF03161787

Welte, N. (2020, February 4). *Simpsonaias ambigua – Pennsylvania: U.S. Fish and Wildlife Service Species Status Assessment (Final)*. U.S. Fish and Wildlife Service. https://www.fws.gov/sites/default/files/documents/Simpsonaias%20ambigua%20-%20PA%20-%20USFWS%20SSA%20(Final)%20-%202-4-20.pdf

Wuebbles, D., Cardinale, B., Cherkauer, K., Davidson-Arnott, R., Hellmann, J., Infante, D. (2019). An assessment of the impacts of climate change on the Great Lakes. Environmental Law & Policy Center. https://www.climatehubs.usda.gov/hubs/midwest/topic/assessment-impacts-climate-change-great-lakes

Zuzek, P. (2020). *Chatham-Kent Lake Erie shoreline study*. Lower Thames Valley Conservation Authority. https://www.lowerthames-conservation.on.ca/wp-content/uploads/2021/09/Chatham-Kent-Lake-Erie-Shoreline-Study-2020.05.25.-reduced-size.pdf